Table 11A.3: Private Resources- American Red Cross

| Public and Private Services and Resources | | | | |
|---|---|---|---|---|
| American Red Cross Chapter (1) | | | | |
| ***NAME*** | *ADDRESS2* | *CITY* | *Longitude* | *Latitude* |
| CRUZ ROJA AMERICANA DE PUERTO RICO | EL CENTRO MEDICO DE RIO PIEDRAS CAMPO | RIO PIEDRAS | -66.072854 | 18.394202 |


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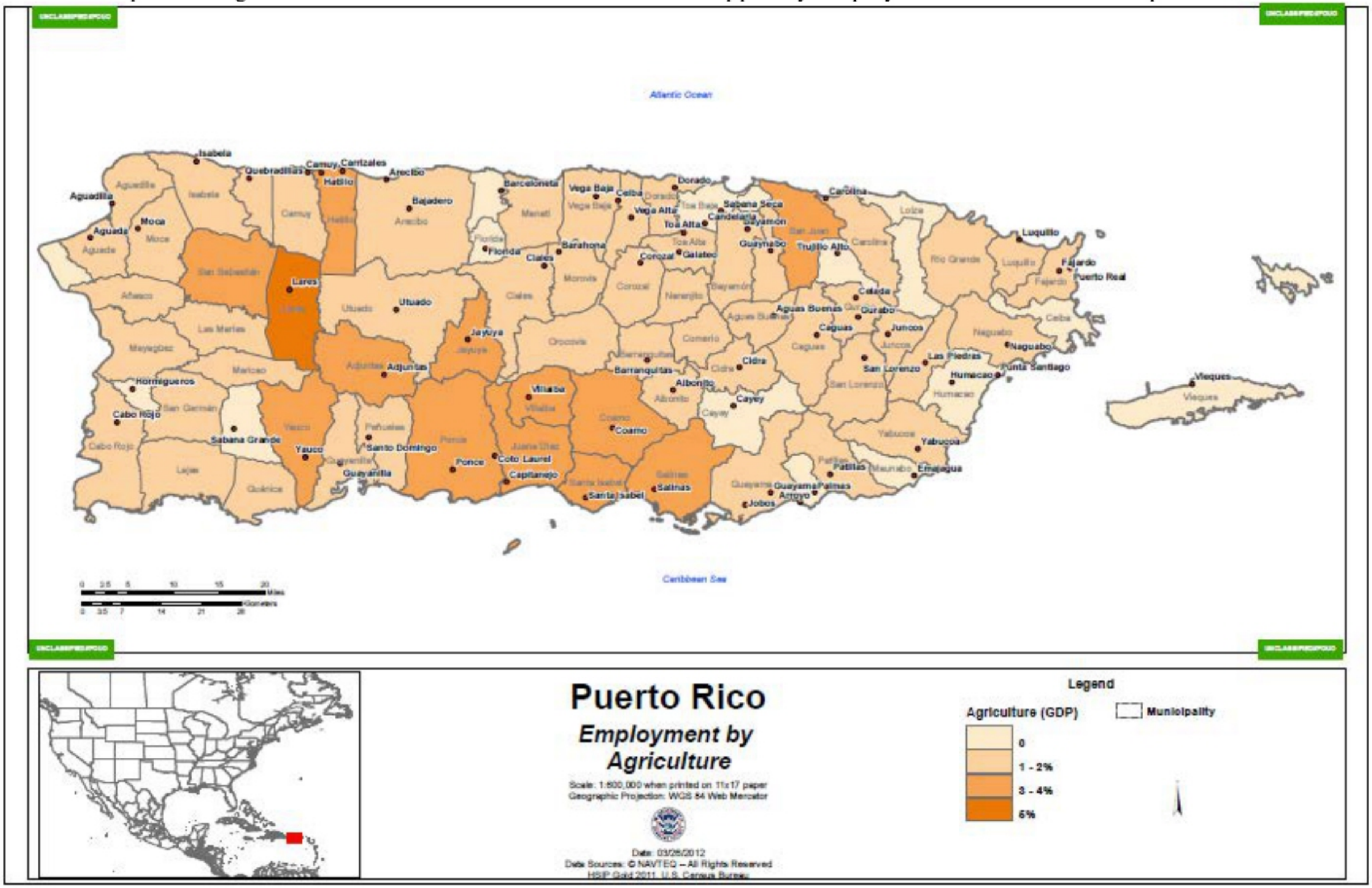
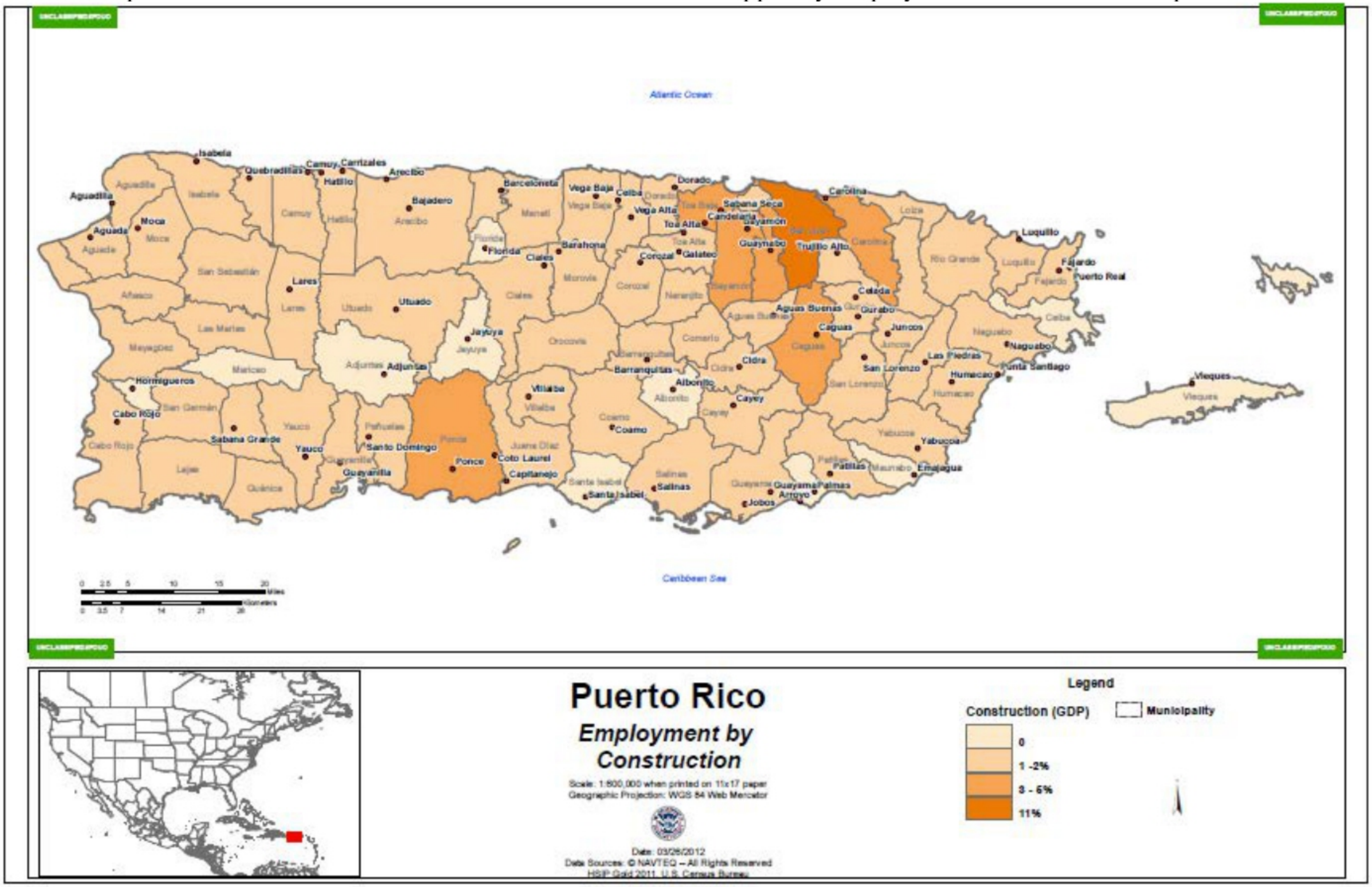
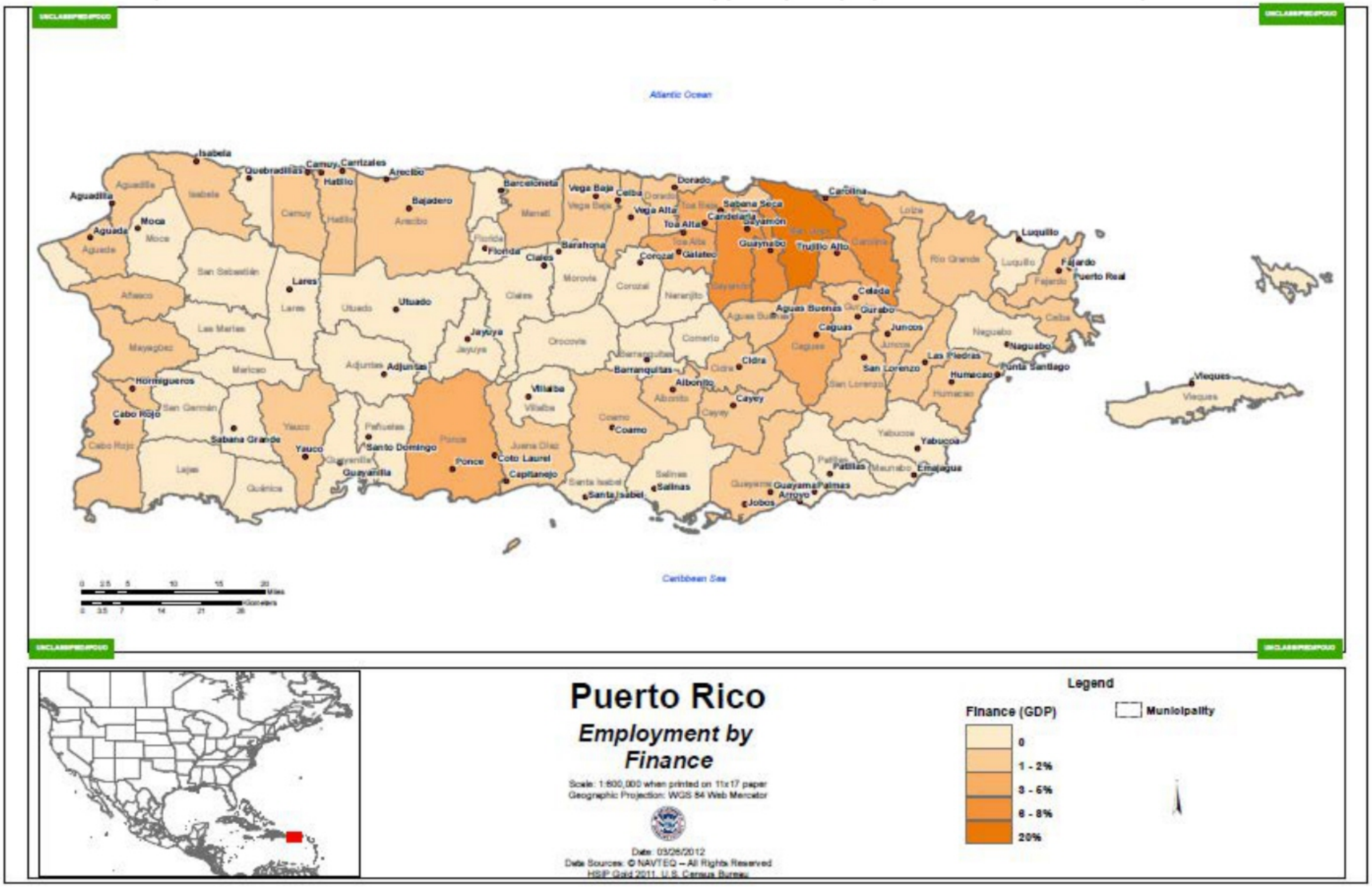
Graph 11B: Agriculture - Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities



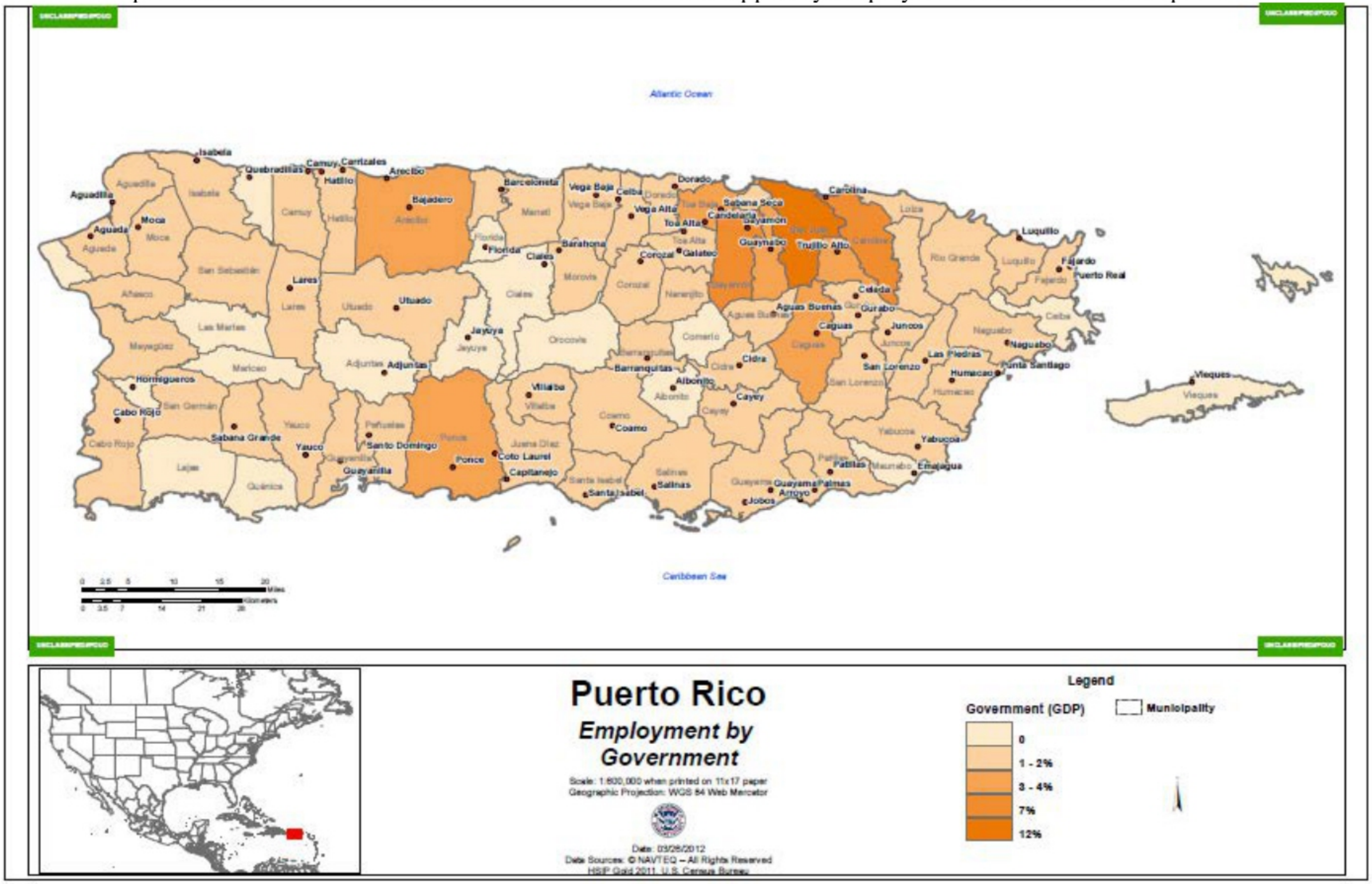
Graph 11C: Construction- Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities



Graph 11D: Finance- Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities



Graph 11E: Government- Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities









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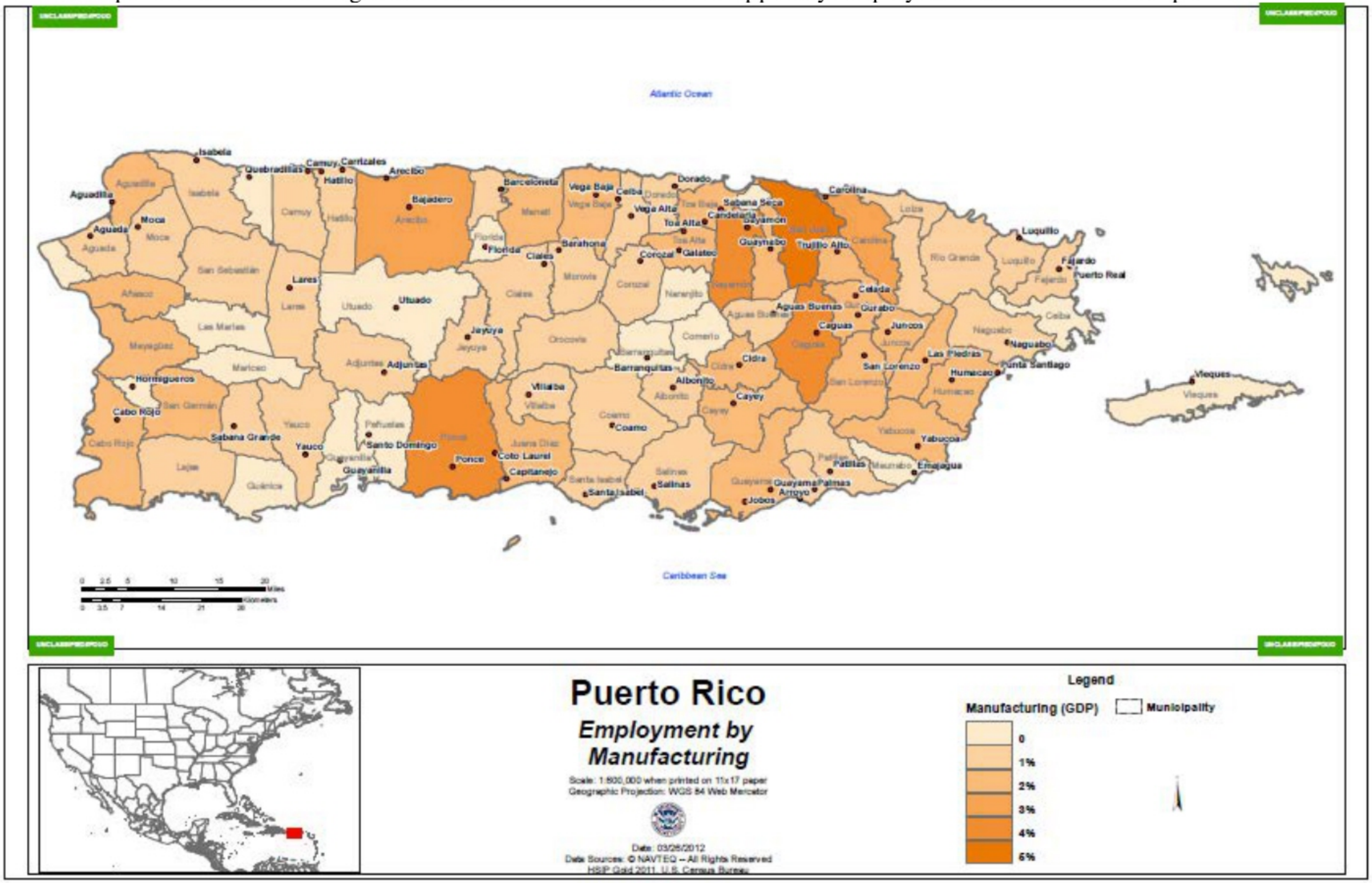
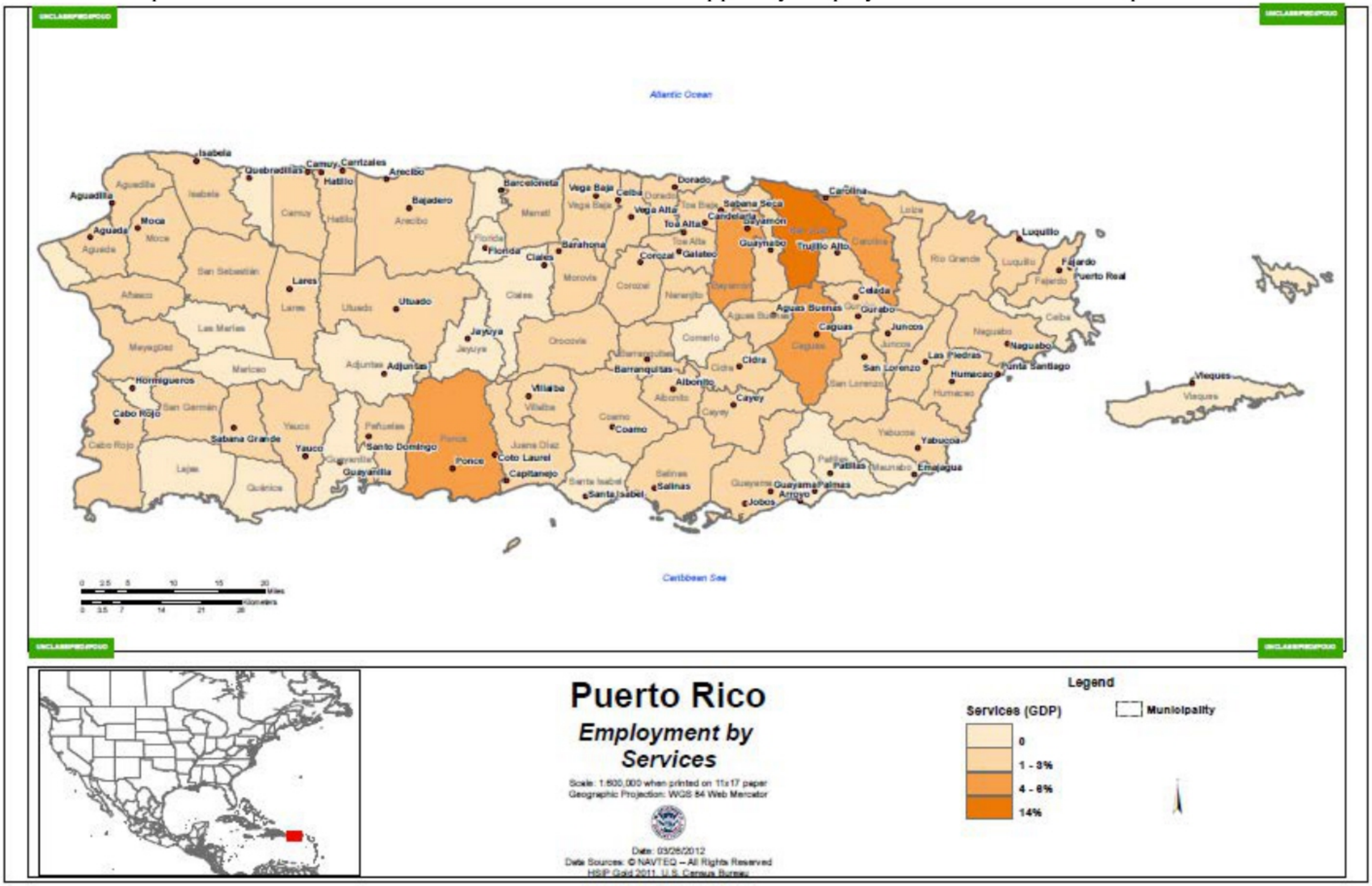
Graph 11F: Manufacturing- Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities



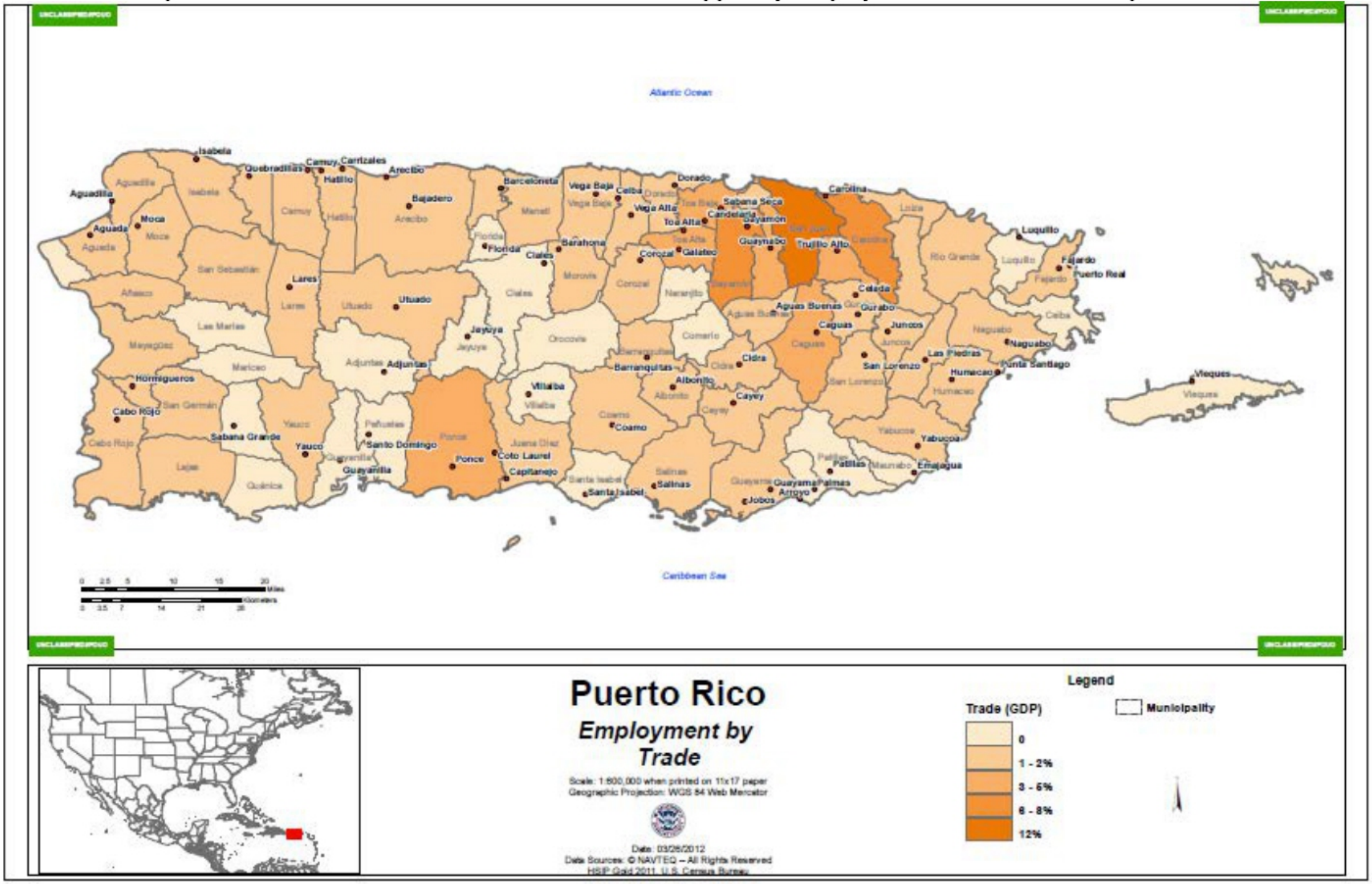



NOTE: Limited Distribution. Release of this information is strictly controlled by DHS.

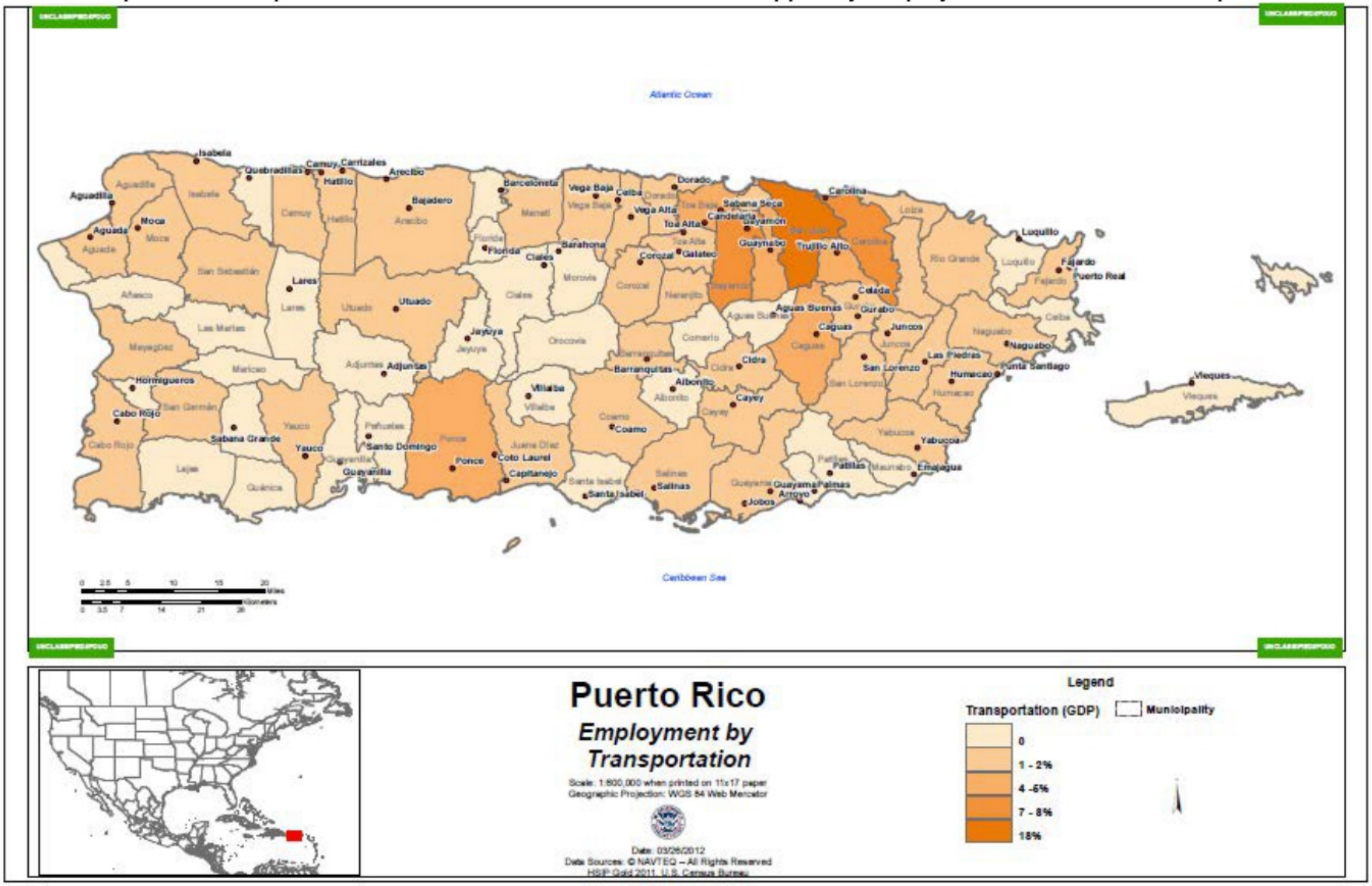
Graph 11G: Services- Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities



Graph 11H: Trade- Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities



Graph 11I: Transportation- Gross Domestic Product Sector Mapped by Employment Rate in the Municipalities





NOTE: Limited Distribution. Release of this information is strictly controlled by DHS.

# 12.0 PUBLIC HEALTH AND MEDICAL SERVICES

Graph 12A: Public Health and Medical Services Puerto Rico

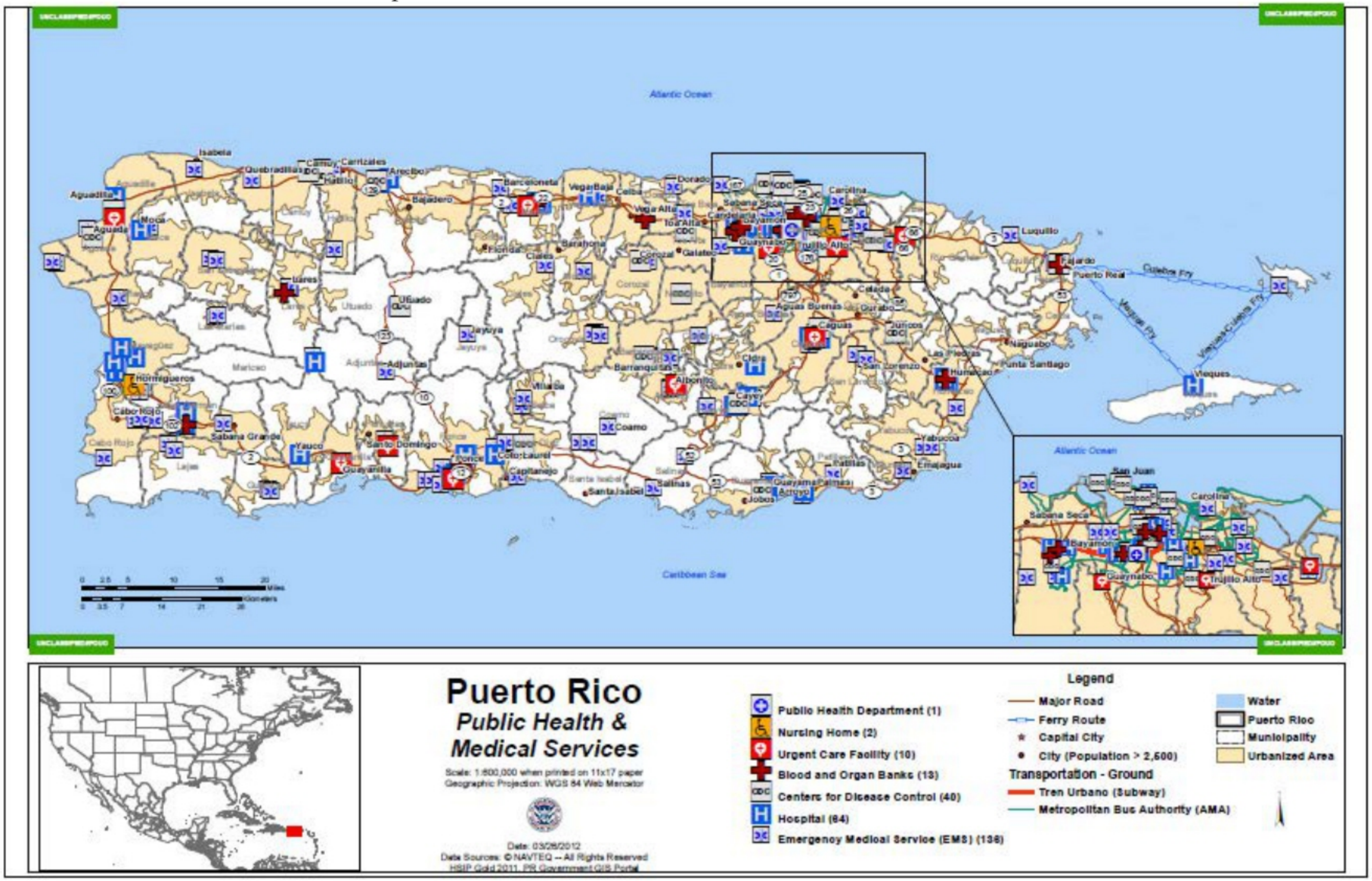


Table 12A: Hospitals Puerto Rico Data

| Hospital (64) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| HOSPITAL PEREA | CALLE DOCTOR BASORA | MAYAGUEZ | -67.140454 | 18.202845 |
| HOSPITAL BELLA VISTA | CARRETERA 349 | MAYAGUEZ | -67.11917 | 18.186765 |
| HOSPITAL SAN CRISTOBAL | CARRETERA 506 | PONCE | -66.548174 | 18.033313 |
| HOSPITAL SAN JORGE | CALLE SAN JORGE 258 | SANTURCE | -66.063045 | 18.446964 |
| ASHFORD PRESBYTERIAN COMMUNITY HOSPITAL | AVENIDA ASHFORD 1451 | SAN JUAN | -66.065647 | 18.455076 |
| HOSPITAL DEL NINO DE PUERTO RICO | CARRETERA 19 | GUAYNABO | -66.108402 | 18.398286 |
| POLICLINICA BELLA VISTA | AUTOPISTA 2 | MAYAGUEZ | -67.149255 | 18.166302 |
| HOSPITAL GENERAL DE CASTANER | CARRETERA 135 | LARES | -66.833349 | 18.180625 |
| HOSPITAL SUSANA CENTENO - CENTRO DE SALUD | CARRETERA 997 | VIEQUES | -65.440134 | 18.142387 |
| HOSPITAL AUXILIO MUTUO | AVENIDA JUAN PONCE DE LEON 25.5 | HATO REY | -66.053007 | 18.409599 |
| HOSPITAL DE PSIQUIATRIA FORENSE | CALLE MAGA | RIO PIEDRAS | -66.076499 | 18.39108 |
| HOSPITAL DE PSIQUIATRIA FORENSE | CARRETERA 14 | PONCE | -66.592443 | 18.03226 |
| HOSPITAL (CLINICA) LAFAYETTE | CARRETERA 753 | ARROYO | -66.058465 | 17.975878 |
| HOSPITAL REGIONAL DOCTOR CAYETANO COLL Y TOSTE | CARRETERA 129 | ARECIBO | -66.731088 | 18.467004 |
| HOSPITAL SAN GERARDO | CARRETERA 844 | RIO PIEDRAS | -66.046253 | 18.372531 |
| HOSPITAL GENERAL MENONITA DE AIBONITO | CALLE JOSE C VAZQUEZ | AIBONITO | -66.261473 | 18.143763 |
| HOSPITAL GENERAL DE UTUADO | 1 CALLE ISAAC MARTINEZ GONZALEZ | UTUADO | -66.701972 | 18.267716 |
| HOSPITAL METROPOLITANO DE SAN GERMAN | CALLE JAVILLA | SAN GERMAN | -67.040133 | 18.082659 |
| HOSPITAL GENERAL MENONITA DE CAYEY | CARRETERA 14 | CAYEY | -66.147139 | 18.124025 |
| FIRST PANAMERICAN HOSPITAL | CARRETERA 787 | CIDRA | -66.135795 | 18.175973 |
| HOSPITAL HEMA SAN PABLO FAJARDO | AVENIDA VALERO | FAJARDO | -65.654432 | 18.336605 |
| HOSPITAL EPISCOPAL SAN LUC | 917 AVENIDA TITO CASTRO | PONCE | -66.594647 | 18.031364 |
| HOSPITAL INTERAMERICANO DE MEDICINA AVANZADA EN HUMACAO | CALLE FONT MARTELO | HUMACAO | -65.828949 | 18.15111 |
| HOSPITAL RYDER MEMORIAL | CALLE FONT MARTELO | HUMACAO | -65.835086 | 18.156003 |
| HOSPITAL DOCTOR SUSONI INCORPORATED | CALLE PALMA 55 | ARECIBO | -66.716884 | 18.473313 |
| HOSPITAL HERMANOS MELENDEZ | CARRETERA 2 | BAYAMON | -66.162721 | 18.39678 |
| HOSPITAL INTERAMERICANO DE MEDICINA AVANZADA | AVENIDA MUNOZ MARIN | CAGUAS | -66.03193 | 18.21789 |
| HOSPITAL SAN JUAN BAPTISTA | CARRETERA 172 | CAGUAS | -66.049579 | 18.220661 |
| HOSPITAL DE AREA | CALLE LUIS BARRERAS 174 | CAYEY | -66.16896 | 18.110532 |
| HOSPITAL DOCTOR DOMINGUEZ INCORPORATED | CALLE FONT MARTELO 300 | HUMACAO | -65.834096 | 18.152792 |
| HOSPITAL DOCTORS CENTER | CARRETERA 2 | MANATI | -66.474111 | 18.433935 |
| HOSPITAL CENTRO MEDICO - ADVANCED CARDIOLOGY CENTER DOCTOR RAMON BETANCES HOSPITAL | AUTOPISTA 2 | MAYAGUEZ | -67.152816 | 18.180683 |
| HOSPITAL SAN CARLOS BORROMEO | CARRETERA 110 | MOCA | -67.110072 | 18.390201 |

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| Hospital (64) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| HOSPITAL DOCTOR PILA LA HOSPITAL POR TODOS | AVENIDA LAS AMERICAS 2431 | PONCE | -66.610704 | 18.003696 |
| HOSPITAL DE DAMAS | CARRETERA 2 2213 | PONCE | -66.617789 | 17.997142 |
| HOSPITAL DE LA CONCEPCION | AUTOPISTA 2 | SAN GERMAN | -67.038205 | 18.098875 |
| HOSPITAL METROPOLITANO | CARRETERA 21 1785 | RIO PIEDRAS | -66.098567 | 18.390195 |
| HOSPITAL SAN JUAN CAPESTRANO | CARRETERA 877 | RIO PIEDRAS | -66.022289 | 18.384535 |
| HOSPITAL SAN FRANCISCO | CALLE JOSE DE DIEGO 371 | SAN JUAN | -66.038758 | 18.398975 |
| HATO REY COMMUNITY HOSPITAL | AVENIDA JUAN PONCE DE LEON 435 | SAN JUAN | -66.056932 | 18.420822 |
| HOSPITAL DEL MAESTRO | CALLE SERGIO CUEVAS BUSTAMANTE 550 | SAN JUAN | -66.068604 | 18.411742 |
| VETERANS AFFAIRS CARIBBEAN HEALTHCARE SYSTEM - SAN JUAN | CALLE CASIA 10 | SAN JUAN | -66.079113 | 18.390621 |
| DOCTORS CENTER HOSPITAL - SAN JUAN | CALLE SAN RAFAEL 1395 | SANTURCE | -66.073768 | 18.446067 |
| HOSPITAL PAVIA | CALLE ASIA 1462 | SANTURCE | -66.069525 | 18.444724 |
| HOSPITAL WILMA VAZQUEZ | CARRETERA 2 | VEGA BAJA | -66.398958 | 18.445484 |
| HOSPITAL DOCTOR TITO MATTEII DE YAUCO / SOUTHERN MEDICAL CENTER | CARRETERA 128 | YAUCO | -66.857556 | 18.031294 |
| HOSPITAL PEDRIATICO UNIVERSITARIO | CARRETERA 21 | SAN JUAN | -66.072444 | 18.396818 |
| CENTRO CARDIOVASCULAR DE PUERTO RICO Y DEL CARIBE DOCTOR RAMON M SUAREZ CALDERON | CARRETERA 21 | SAN JUAN | -66.072644 | 18.398588 |
| HOSPITAL ALEJANDRO OTERO LOPEZ | CALLE HERNANDEZ CARRION CARRETERA 2 INTERSECTION 668 | MANATI | -66.482296 | 18.434597 |
| HOSPITAL ONCOLOGICO | CARRETERA 21 | RIO PIEDRAS | -66.072624 | 18.395408 |
| SAN JUAN MUNICIPAL HOSPITAL | CARRETERA 21 | RIO PIEDRAS | -66.074708 | 18.395085 |
| CENTRO MEDICO | CARRETERA 21 | RIO PIEDRAS | -66.07349 | 18.395847 |
| HOSPITAL REGIONAL UNIVERSITARI DR RAMON RUIZ ARNAU | AVENIDA LAUREL | BAYAMON | -66.154034 | 18.367627 |
| HOSPITAL UNIVERSITARIO DE ADULTOS | CARRETERA 21 | RIO PIEDRAS | -66.073326 | 18.39696 |
| HEALTH SOUTH REHABILITATION HOSPITAL | CARRETERA 21 | SAN JUAN | -66.073325 | 18.39696 |
| HOSPITAL SAN PABLO - HOSPITAL INTERAMERICANO DE MEDICINA AVANZADA | CALLE SANTA CRUZ 70 | BAYAMON | -66.147544 | 18.397706 |
| HOSPITAL INDUSTRIAL CENTRO MEDICO | PASEO DOCTOR JOSE CELSO BARBOAS | RIO PIEDRAS | -66.073127 | 18.394529 |
| HOSPITAL DE TRAUMAS CENTRO MEDICO | PASEO DOCTOR JOSE CELSO BARBOAS | RIO PIEDRAS | -66.073837 | 18.393686 |
| HOSPITAL SAN ANTONIO | CALLE POST 18 NORTE | MAYAGUEZ | -67.140993 | 18.203188 |
| HOSPITAL DE SIQUIATRIA CORRECCIONAL | CALLE TENIENTE CESAR L GONZALEZ 1106 | RIO PIEDRAS | -66.072968 | 18.391697 |
| HOSPITAL BUEN SAMARITANO | CALLE SEVERANO CUEVAS | AGUADILLA | -67.15089 | 18.442803 |
| HOSPITAL EPISCOPAL CRISTO REDENTOR | AVENIDA PEDRO ALBIZU CAMPOS | GUAYAMA | -66.114574 | 17.973688 |

| Hospital (64) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| HOSPITAL SANTA ROSA NUMERO 2 | 135 AVENIDA LOS VETERANOS | GUAYAMA | -66.104486 | 17.981717 |
| HOSPITAL MATILDE BRENES | CALLE 2 J-9 EXTENTION HERMANOS DAVILA | BAYAMON | -66.16617 | 18.398025 |

Table 12B: Emergency Medical Services Puerto Rico Data

| Emergency Medical Service (EMS) (136) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| PARQUE DE BOMBAS - RINCON | CALLE HERMAN OCASIO | RINCON | -67.245118 | 18.337743 |
| LIFE AMBULANCE SERVICE | CALLE CALIMANO 62 NORTE | GUAYAMA | -66.113795 | 17.989899 |
| MARRERO AMBULANCE SERVICE | CALLE 4 DE JULIO 2 | OROCOVIS | -66.389921 | 18.227821 |
| MEDICO UNO AMBULANCE SERVICE | CALLE 50 SO 1400 | RIO PIEDRAS | -66.085995 | 18.393443 |
| NEW LIFE AMBULANCE SERVICE | CALLE 39 B-C 1 | BAYAMON | -66.190325 | 18.365863 |
| STATE EMERGENCY MEDICAL SERVICES - LAJAS | CARRETERA 101 | LAJAS | -67.067121 | 18.048164 |
| SAN JOSE AMBULANCE SERVICE | CARRETERA 155 SALIDA HACIA COAMO 42 | OROCOVIS | -66.3933 | 18.224601 |
| GUTIERREZ AMBULANCE | CARRETERA 7722 | AIBONITO | -66.211798 | 18.110541 |
| AYALAS AMBULANCE | CALLE 45 AND CALLE 1 | CAROLINA | -65.928163 | 18.366167 |
| ADVANCE AMBULANCE | CARRETERA 159 Y CARRETERA 164 | COROZAL | -66.305627 | 18.340442 |
| MELENDEZ AMBULANCE SERVICE | CALLE ESMERALDAS P-6 | PONCE | -66.549029 | 18.044765 |
| MEDIC AMBULANCE SERVICE | CARRETERA 129 | ARECIBO | -66.731199 | 18.467308 |
| MEDIC AMBULANCE SERVICE | CALLE SOCORRO 55 | QUEBRADILLAS | -66.934244 | 18.4704 |
| CRAFF AMBULANCE SERVICE | CARRETERA 102 | CABO ROJO | -67.118365 | 18.086662 |
| GOLDEN AMBULANCE SERVICE | CALLE ESTEBAN B CRUZ 83 | GUAYAMA | -66.113917 | 17.977681 |
| CALDERON AMBULANCE STATION 2 | AVENIDA EMERITO ESTRADA 1524 | SAN SEBASTIAN | -66.99995 | 18.343347 |
| GEMS AMBULANCE | CARRETERA 444 | MOCA | -67.102712 | 18.393087 |
| EMERGENCY ON WHEELS | CARRETERA 102 | SAN GERMAN | -67.088228 | 18.086755 |
| BETTOS AMBULANCE SERVICE | CALLE TOPACIO 197 | SAN GERMAN | -67.037161 | 18.077194 |
| LEE AMBULANCE | CALLE MATIAS BRUGMAN 47 | LAS MARIAS | -66.992465 | 18.252406 |
| CASTILLO LIFE SUPPORT | CALLE EDUARDO RUBERTE 15 | PONCE | -66.632331 | 18.01116 |
| TROPICAL AMBULANCE | CARRETERA 111 | MOCA | -67.09761 | 18.387415 |
| STATE EMERGENCY MEDICAL SERVICES - COAMO | AVENIDA LUIS MUNOZ MARIN CARRETERA 138 | COAMO | -66.368598 | 18.07606 |
| STATE EMERGENCY MEDICAL SERVICES - GUAYAMA | ANTIGUA PLAZA DEL MERCADO | GUAYAMA | -66.110546 | 17.979989 |
| CULEBRA HOSPITAL | CALLE WILLIAM FONT FINAL | CULEBRA | -65.303083 | 18.302814 |
| STATE EMERGENCY MEDICAL SERVICES - HORMIGUEROS | CARRETERA 345 | HORMIGUEROS | -67.121691 | 18.139289 |
| FLASH AMBULANCE SERVICE | 2068 AVENIDA D | SAN JUAN | -66.05308 | 18.43882 |
| MEDINA MEDICAL TRANSPORT | 601 AVENIDA BARBOSA | SAN JUAN | -66.043909 | 18.413085 |
| STATE EMERGENCY MEDICAL SERVICES - PLAZA LAS AMERICAS | 505 AVENIDA FRANKLIN DELANOR ROOSEVELT | SAN JUAN | -66.075595 | 18.422871 |
| STATE EMERGENCY MEDICAL SERVICES - GUANICA | CARRETERA 116 | GUANICA | -66.907916 | 17.977206 |
| CENTRO CARDIOVASCULAR AMBULANCE SERVICE | MARGINAL 1 EXTENSION SAN SALVADOR | MANATI | -66.485919 | 18.432296 |
| STATE EMERGENCY MEDICAL SERVICES - ADJUNTAS | CALLE DOCTOR SANTOS | ADJUNTAS | -66.720771 | 18.163415 |

| Emergency Medical Service (EMS) (136) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| | DEFENDINI 4 | | | |
| STATE EMERGENCY MEDICAL SERVICES - MAUNABO | CALLE ANTONIO R BARCELO 40 | MAUNABO | -65.900975 | 18.007287 |
| STATE EMERGENCY MEDICAL SERVICES - AGUADA | CARRETERA 441 | AGUADA | -67.194469 | 18.391888 |
| STATE EMERGENCY MEDICAL SERVICES - JUNCOS | CARRETERA 31 INTERIOR | JUNCOS | -65.907586 | 18.231215 |
| STATE EMERGENCY MEDICAL SERVICES - CANOVANAS | CALLE AUTONOMIA | CANOVANAS | -65.899911 | 18.372185 |
| STATE EMERGENCY MEDICAL SERVICES - SABANA GRANDE | CARRETERA 102 | SABANA GRANDE | -66.979553 | 18.081013 |
| RODRIGUEZ AMBULANCE SERVICE | CALLE SAN JOSE 41 ESTE | GUAYAMA | -66.112245 | 17.983083 |
| AMANDA AMBULANCE SERVICE | CALLE 1 111 | SALINAS | -66.247347 | 18.028088 |
| SAN FRANCISCO AMBULANCE SERVICE | CALLE PAZ 98 | AGUADA | -67.185547 | 18.378936 |
| STATE EMERGENCY MEDICAL SERVICES - SAN LORENZO | CARRETERA 183 INTERIOR | SAN LORENZO | -65.97279 | 18.190648 |
| STATE EMERGENCY MEDICAL SERVICES - FAJARDO | 1 CALLE 5 | FAJARDO | -65.660538 | 18.338591 |
| JERUSALEM HOME AMBULANCE INCORPORATED | CARRETERA 183 | SAN LORENZO | -65.974455 | 18.193251 |
| PARQUE DE BOMBAS - LAJAS | CALLE 65 DE INFANTERIA 255 | LAJAS | -67.056825 | 18.039707 |
| MALAVE AMBULANCE SERVICE | CALLE 65 INFANTERIA 89 | ANASCO | -67.144582 | 18.280623 |
| PARQUE DE BOMBAS - PATILLAS | CARRETERA 3 INTERIOR | PATILLAS | -66.012045 | 18.000971 |
| PARQUE DE BOMBAS - PONCE | CALLE ALCAZAR Y AVENIDA BOULEVARD MIGUEL POU | PONCE | -66.604515 | 18.013009 |
| PARQUE DE BOMBAS - CIALES | CALLE PALMER CABALINES 2 | CIALES | -66.468383 | 18.33386 |
| PARQUE DE BOMBAS - DORADO | CALLE MENDEZ VIGO | DORADO | -66.265522 | 18.460282 |
| PARQUE DE BOMBAS - AIBONITO | CALLE FELIX RIOS | AIBONITO | -66.270357 | 18.13855 |
| PARQUE DE BOMBAS - CANOVANAS | CALLE CORCHADO Y CALLE A | CANOVANAS | -65.898906 | 18.377342 |
| MANEJO DE EMERGENCIAS | CARRETERA 149 | VILLALBA | -66.506016 | 18.108895 |
| PARQUE DE BOMBAS - CAYEY | CARRETERA 1 | CAYEY | -66.161006 | 18.106136 |
| PARQUE DE BOMBAS - GUANICA | CARRETERA 333 | GUANICA | -66.903885 | 17.973171 |
| PARQUE DE BOMBAS - GUAYAMA | AVENUE PRINCIPAL 100 | GUAYAMA | -66.114164 | 17.972034 |
| PARQUE DE BOMBAS - HORMIGUEROS | CARRETERA 345 | HORMIGUEROS | -67.111649 | 18.131922 |
| FORT BUCHANAN FIRE AND EMERGENCY RESCUE SERVICES-DOD | CHRISMAN ROAD | FORT BUCHANAN | -66.117989 | 18.412649 |
| PARQUE DE BOMBAS - SAN LORENZO | CARRETERA 183 | SAN LORENZO | -65.958928 | 18.183473 |
| PARQUE DE BOMBAS / SERVICIO MANEJO DE AMBULANCIA - MAYAGUEZ | CALLE SAN RAFAEL 214 | MAYAGUEZ | -67.133806 | 18.199526 |
| PARQUE DE BOMBAS - LARES | CARRETERA 111 | LARES | -66.87374 | 18.297413 |
| NATANAEL AMBULANCE INCORPORATED | CARRETERA 14 COMUNIDAD LOS LLANOS | COAMO | -66.413779 | 18.051706 |
| CRISTAL AMBULANCE SYSTEMS - GUAYAMA | B 3 VILLA ROSA AVENIDA LOS VETERANOS | GUAYAMA | -66.0926 | 17.97863 |
| ARROW AMBULANCE SERVICE | CARRETERA 8 CALLE HEMOGENS FIGUEROA | CAROLINA | -65.983584 | 18.385624 |
| GOOD LUCK AMBULANCE SERVICE | AVENIDA CAMPO RICO CALLE 12 | CAROLINA | -65.971354 | 18.418242 |

| Emergency Medical Service (EMS) (136) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| STATE EMERGENCY MEDICAL SERVICES - MANATI | BLOQUE 8 4 SABANA GARDEN 100 PASEO DE LA ATENAS | MANATI | -66.489971 | 18.429879 |
| STATE EMERGENCY MEDICAL SERVICES - ISABELA | CALLE SALUD | ISABELA | -67.025214 | 18.488256 |
| SOTO AMBULANCE SERVICE | CARRETERA 14 | COAMO | -66.399949 | 18.052613 |
| AMBULANCIAS EMERGENCIAS DEL SUR | 3069 CALLE BUENOS AIRES | PONCE | -66.611536 | 18.004986 |
| STATE EMERGENCY MEDICAL SERVICES - SAN SEBASTIAN | CARRETERA 111 | SAN SEBASTIAN | -66.99015 | 18.341539 |
| COQUI AMBULANCE SERVICE | CALLE FRATERNIDAD 39 | CAGUAS | -66.050372 | 18.206162 |
| RENAL LIFE AMBULANCE SERVICE | CALLE ESPANA Y CALLE 41 | BAYAMON | -66.159518 | 18.368473 |
| RODRIGUEZ AMBULANCE SERVICE | CARRETERA 156 | OROCOVIS | -66.381462 | 18.222421 |
| SANTIAGO AMBULANCE | CALLE 3 SOLAR A-5 | JUANA DIAZ | -66.527845 | 18.048716 |
| CAROL AMBULANCE SERVICE | CALLE BERNANDINO TORRES 1 | CAGUAS | -66.039854 | 18.226963 |
| GOOD CARE AMBULANCE SERVICE | TUNEL CARWASH OFFICES 21, 22, 23 | SAN JUAN | -66.03515 | 18.394238 |
| CRISTAL AMBULANCE SYSTEMS - YABUCOA | CALLE MARGINAL SOLAR 6 | YABUCOA | -65.868943 | 18.043936 |
| SAINT PETER AMBULANCE | CALLE MORSE 211 | ARROYO | -66.061007 | 17.966055 |
| CALDERON AMBULANCE STATION 1 | CALLE ZAFIRO 183 | AGUADILLA | -67.150269 | 18.43837 |
| PUERTO RICO MEDICAL SERVICE | CARRETERA 444 | MOCA | -67.095437 | 18.395681 |
| MED LIFE | CARRETERA 102, CALLE PARQUE OESTE 100 | CABO ROJO | -67.109357 | 18.088233 |
| MORALES AMBULANCE SERVICE | R-8 CALLE K | PONCE | -66.657659 | 17.992628 |
| MELENDEZ PARAMEDICAL SERVICES | CARRETERA 14 | JUANA DIAZ | -66.531761 | 18.050989 |
| STATE EMERGENCY MEDICAL SERVICES - EL TUQUE | AVE PUNTO DE ORO | PONCE | -66.646708 | 17.991147 |
| STATE EMERGENCY MEDICAL SERVICES - PENUELAS | CALLE AMALIA MARIN FINAL | PENUELAS | -66.72368 | 18.057698 |
| STATE EMERGENCY MEDICAL SERVICES - GUAYANILLA | 13 CALLE JOSE DE DIEGO | GUAYANILLA | -66.79164 | 18.01788 |
| STATE EMERGENCY MEDICAL SERVICES - YAUCO | CARRETERA 128 | YAUCO | -66.859423 | 18.032748 |
| STATE EMERGENCY MEDICAL SERVICES - CAROLINA | AVENIDA ROBERTO CLEMENTE | CAROLINA | -65.96604 | 18.398308 |
| STATE EMERGENCY MEDICAL SERVICES - SAN GERMAN | 10 CALLE JAVILLA | SAN GERMAN | -67.040225 | 18.082569 |
| STATE EMERGENCY MEDICAL SERVICES - YABUCOA | CARRETERA 901 | YABUCOA | -65.855738 | 18.044927 |
| STATE EMERGENCY MEDICAL SERVICES - CAGUAS | CALLE LUXEMBURGO | CAGUAS | -66.044546 | 18.213099 |
| STATE EMERGENCY MEDICAL SERVICES - LARES | AVE LOS PATRIOTAS | LARES | -66.875279 | 18.298658 |
| STATE EMERGENCY MEDICAL SERVICES - MAYAGUEZ | ESQ NENADICH-CENTRO GUBERNAMENTAL | MAYAGUEZ | -67.144399 | 18.197915 |
| STATE EMERGENCY MEDICAL SERVICES - LUQUILLO | BALNEARIO LA MONSERRATE | LUQUILLO | -65.729907 | 18.383141 |
| STATE EMERGENCY MEDICAL SERVICES - BUENAS | CALLE RAFAEL LAZA | AGUAS BUENAS | -66.105338 | 18.257384 |
| STATE EMERGENCY MEDICAL SERVICES - AIBONITO | 198 CALLE JULIO ROSARIO | AIBONITO | -66.270393 | 18.137703 |
| STATE EMERGENCY MEDICAL SERVICES - COMERIO | CARREERA 156 | COMERIO | -66.225347 | 18.221458 |
| STATE EMERGENCY MEDICAL SERVICES - CIALES | CALLE PALMER 52 | CIALES | -66.468375 | 18.333653 |
| STATE EMERGENCY MEDICAL SERVICES - UTUADO | CALLE SGTO MALARET JUARBE I | UTUADO | -66.698278 | 18.265768 |

| Emergency Medical Service (EMS) (136) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| STATE EMERGENCY MEDICAL SERVICES - MOCA | CALLE MONSENOR J TORRES | MOCA | -67.110049 | 18.391315 |
| STATE EMERGENCY MEDICAL SERVICES - AGUADILLA | CARRETERA 2 | AGUADILLA | -67.147612 | 18.438164 |
| PRIORITY LIFE INCORPORATED | 159 CALLE PARIS | SAN JUAN | -66.049589 | 18.423354 |
| STATE EMERGENCY MEDICAL SERVICES - PONCE | CARRETERA 14 | PONCE | -66.592512 | 18.031926 |
| STATE EMERGENCY MEDICAL SERVICES - RINCON | CARRETERA 115 | RINCON | -67.250537 | 18.340444 |
| STATE EMERGENCY MEDICAL SERVICES - CASTANER | CARRETERA 135 | LARES | -66.836931 | 18.189363 |
| RESCUE AMBULANCE SERVICE | CARRETERA 844 | SAN JUAN | -66.045702 | 18.372314 |
| STATE EMERGENCY MEDICAL SERVICES - RIO PIEDRAS | AVENIDA ELEANOR ROOSEVELT 215A | SAN JUAN | -66.061965 | 18.419859 |
| STATE EMERGENCY MEDICAL SERVICES - AUTOPISTA | AUTOPISTA 22 | GUAYNABO | -66.246656 | 18.418587 |
| STATE EMERGENCY MEDICAL SERVICES - AEROMED | HELIPUERTO CENTRO MEDICO | RIO PIEDRAS | -66.073281 | 18.393487 |
| STATE EMERGENCY MEDICAL SERVICES - BARRANQUITAS | CALLE DEL PARQUE | BARRANQUITAS | -66.270587 | 18.186284 |
| STATE EMERGENCY MEDICAL SERVICES - VILLALBA | CARRETERA 149 AND CARRETERA 589 | VILLALBA | -66.502728 | 18.122343 |
| STATE EMERGENCY MEDICAL SERVICES - ARECIBO | 156 AVENIDA HOSTOS | ARECIBO | -66.726181 | 18.470992 |
| CUERPO DE EMERGENCIAS MEDICAS DE PUERTO RICO | 9 MARGINAL BUCHANAN | GUAYNABO | -66.104232 | 18.413704 |
| STATE EMERGENCY MEDICAL SERVICES - CABO ROJO | INTERSECTION OF CARRETERA 101 Y CARRETERA 307 | CABO ROJO | -67.168529 | 18.027105 |
| MIRAMAR AMBULANCE AND MEDICAL SUPPLIES | CARRETERA 2 | HATILLO | -66.80527 | 18.488629 |
| LIFE EMERGENCY MEDICAL AMBULANCE | CARRETERA 441 | AGUADA | -67.195494 | 18.391425 |
| STATE EMERGENCY MEDICAL SERVICES - JUANA DIAZ | CARRETERA 14 | JUANA DIAZ | -66.503679 | 18.052543 |
| STATE EMERGENCY MEDICAL SERVICES - LAS MARIAS | 127 CARRETERA 119 | LAS MARIAS | -66.988509 | 18.253243 |
| STATE EMERGENCY MEDICAL SERVICES - CAMUY | AVENIDA MUNOZ RIVERA 62 | CAMUY | -66.842154 | 18.483484 |
| ATENAS AMBULANCE SERVICES | CARRETERA 2 | BARCELONETA | -66.5228 | 18.42911 |
| STATE EMERGENCY MEDICAL SERVICES - AEROPUERTO LUIS MUNOZ MARIN | PRIMER NIVEL TERMINAL C | ISLA VERDE | -66.004183 | 18.437307 |
| D W N EMERGENCY CALL AMBULANCE | CARRETERA 848 | CAROLINA | -65.995842 | 18.380567 |
| CUERPO VOLUNTARIO DE SERVIZIOS | CALLE REVERENDO VICENTE LOPEZ 1 | HATILLO | -66.822034 | 18.489219 |
| STATE EMERGENCY MEDICAL SERVICES - CAYEY | CALLE MARGINAL NORTH | CAYEY | -66.13939 | 18.122225 |
| PROFESSIONAL AMBULANCE INCORPORATED | CALLE DORADO | PONCE | -66.634104 | 17.984416 |
| STATE EMERGENCY MEDICAL SERVICES - JAYUYA | RAMAL 141 | JAYUYA | -66.59177 | 18.225588 |
| STATE EMERGENCY MEDICAL SERVICES - BAYANEY | CARRETERA 129 | HATILLO | -66.803342 | 18.360423 |
| STATE EMERGENCY MEDICAL SERVICES - VEGA BAJA | AVENIDA VILLA BINARES 81 | VEGA BAJA | -66.383895 | 18.442728 |
| VIEQUES FIRE STATION | CARRETERA 997 | VIEQUES | -65.43971 | 18.140863 |
| STATE EMERGENCY MEDICAL SERVICES - HUMACAO | CARRETERA 923 BO BUENA VISTA | HUMACAO | -65.81639 | 18.10781 |
| SUPRAMED AMBULANCE SERVICE | CALLE JOSE DE DIEGO 561 | RIO PIEDRAS | -66.030126 | 18.397811 |
| STATE EMERGENCY MEDICAL SERVICES - BARCELONETA | CALLE RVDO A VILLAMIL | BARCELONETA | -66.539908 | 18.456793 |
| QUINONES AMBULANCE SERVICE | CALLE VICTORIA MATEO 35 | SALINAS | -66.296938 | 17.978177 |

| Emergency Medical Service (EMS) (136) | | | | |
|---|---|---|---|---|
| NAME | ADDRESS | CITY | LONGITUDE | LATITUDE |
| RODRIGUEZ AMBULANCE SERVICE | CARRETERA 1 | JUANA DIAZ | -66.513244 | 17.997125 |
| STATE EMERGENCY MEDICAL SERVICES - MOROVIS | CALLE BALDORIOTY ESQUINA B | MOROVIS | -66.40767 | 18.325027 |
| STATE EMERGENCY MEDICAL SERVICES - PUNTA SALINAS | CARRETERA 165 | LEVITTOWN | -66.188603 | 18.462943 |
| MEDICAL AMBULANCE SERVICE | 591 CALLE JOSE DE DIEGO | RIO PIEDRAS | -66.0278 | 18.397569 |

Table 12C: Public Health Department

| Public Health Department (1) | | | | |
|---|---|---|---|---|
| ***NAME*** | *ADDRESS* | *CITY* | *LONGITUDE* | *LATITUDE* |
| DEPARTAMENTO DE SALUD | CALLE MAGA | SAN JUAN | -66.076503 | 18.390004 |

Table 12D: Nursing Homes Puerto Rico Data

| Nursing Home (2) | | | | |
|---|---|---|---|---|
| ***NAME*** | *ADDRESS* | *CITY* | *LONGITUDE* | *LATITUDE* |
| SAN JUAN AGING CENTER | AVENIDA 65 INFANTERIA | RIO PIEDRAS | -66.015619 | 18.396588 |
| SERVICIOS INTEGRADOS DE REHABILITACION DEL OESTE INCORPORADO | L-10 CALLE 4 | HORMIGUEROS | -67.120627 | 18.142767 |

Table 12E: Urgent Care Facilities Puerto Rico Data

| Urgent Care Facility (10) | | | | |
|---|---|---|---|---|
| ***NAME*** | *ADDRESS* | *CITY* | *LONGITUDE* | *LATITUDE* |
| CENTRO DE DIAGNOSTICO Y TRATAMIENTO DE CANOVANAS | CALLE CORCHADO | CANOVANAS | -65.898155 | 18.37788 |
| GUAYNABO MEDICAL MALL | AVENIDA LAS CUMBRES FINAL 140 | GUAYNABO | -66.112841 | 18.361568 |
| CONSEGO DE LA SALUD DE LA COMUNIDAD DE LA PLAYA DE PONCE | AVENIDA HOSTOS INTERIOR 1034 | PONCE | -66.614256 | 17.992627 |
| HOSPITAL MUNICIPAL | CARRETERA 2 | MANATI | -66.49552 | 18.429227 |
| CENTRO DE EMERGENCIA Y CUIDADO MEDICO DEL SUR | CARRETERA 385 | PENUELAS | -66.717496 | 18.045912 |
| CENTRO MEDICO DE TRUJILLO ALTO | CALLE CARITE | TRUJILLO ALTO | -66.005023 | 18.363672 |
| EL CENTRO HERIDAS Y ULCERAS | CALLE JOSE C VAZQUEZ | AIBONITO | -66.261341 | 18.143154 |
| AGUADILLA MEDICAL SERVICES | CARRETERA 2 | AGUADILLA | -67.151792 | 18.408844 |
| CENTRO DE DIAGNOSTICO Y TRATAMIENTO DE GUAYANILLA | CALLE JOSE DE DIEGO 13 | GUAYANILLA | -66.791742 | 18.017989 |
| HEALTHCARE AMBULATORY SERVICES INCORPORATED | CARRETERA 172 | CAGUAS | -66.040812 | 18.219365 |

Table 12F: Blood and Organ Banks Puerto Rico Data

| Blood and Organ Banks (13) | | | | |
|---|---|---|---|---|
| **Business Name** | Address | City | Latitude | Longitude |
| Novis Pharmaceuticals, LLC | Oller Medical Plaza II | Bayamon | 18.38849 | -66.1662 |
| Servicio De Sangre Cruz Roja Americana | Rovira Ofc Park 619 Ave 4 | Ponce | 18.0121 | -66.6011 |
| Simple Medical Services of PR | Luis Munoz Rivera 14 | Vega Alta | 18.4093 | -66.3103 |
| Banco De Sangre Servicios Mutos, Inc | 662 Ave Ponce De Leon | San Juan | 18.411588 | -66.054166 |
| Salud Inc | 1122 Calle 54 SE Antico | Rio Piedras | 18.390793 | -66.091216 |
| Laboratorio Clinico San Martin Inc | Pedro Albizu Campos Dr 75 | Lares | 18.2917 | -66.8825 |
| American National Red Cross | Medical Ctr Grn Bo Monaci | San Juan | 18.3959 | -66.0735 |
| Centro De Hematologia Y Oncologia | 410 Ave General Valero # 404 | Fajardo | 18.3358 | -65.6532 |
| PR Tissue Reserve Foundation | 160 Ave Univ Inter | San German | 18.08003 | -67.03848 |
| Grupo Hematologico Oncologico | 1755 Carr 2 Ste 109 | Bayamon | 18.396109 | -66.157865 |
| Banco De Sangre Humacao, Inc. | 255 Calle Font Martelo | Humacao | 18.1527 | -65.8333 |
| Las Americas Laboratory Inc | 400 Ave Domenech Ste 203b | San Juan | 18.412864 | -66.068301 |
| Manati Blood Center Inc | B17 Calle Marginal | Manati | 18.43252 | -66.48489 |

Table 12G: Center for Disease Control Puerto Rico Data

| Centers for Disease Control (40) | | | | |
|---|---|---|---|---|
| **Business Name** | **Address** | **City** | **Latitude** | **Longitude** |
| San Juan Bautista Medical Center, Inc. | Cond De Diego | San Juan | 18.451375 | -66.064526 |
| Programa De Alcoholismo | Victoria Industrial Park | Carolina | 18.37392 | -65.94765 |
| San Juan Bautista Medical Center, Inc. | Georgetti St | Naranjito | 18.2883 | -66.2526 |
| Municipio De San Juan | O54 Ave Park Gdns # 54 | San Juan | 18.38565 | -66.0372 |
| Youth Services | 252 Calle De San Jose | San Juan | 18.464486 | -66.117037 |
| National Institutes of Health | 1306 Ave Ponce De | San Juan | 18.3642 | -66.0194 |
| Department of Health | Medical Ctr Bldg A | Rio Piedras | 18.40657 | -66.00339 |
| San Juan Bautista Med Ctr | Centro Medico Bo Monacil | San Juan | 18.451375 | -66.064526 |
| San Juan Bautista Medical Center | 16 Calle Barcelo | TOA Alta | 18.3887 | -66.2463 |
| Corporacion De Servicios Integrales De Salud De La Montana | 53 Calle Barcelo | Barranquitas | 18.1861 | -66.3061 |
| Corozal, Municipio De | 9 Calle Cervantes | Corozal | 18.341 | -66.3175 |
| Department of Health | Old Psychtrc Hosp Bdlg | San Juan | 18.43924 | -66.06046 |
| Administracion De Familias Y Ninos | Ave Ponce De Leon Stp2 | San Juan | 18.3642 | -66.0194 |
| Department of Health | Pedro Albizu Campo Ave | Guayama | 17.9762 | -66.1246 |
| Puerto Rico Department of Health | Cerrenos Ze Cntr 164 | San Juan | 18.3642 | -66.0194 |
| San Juan Bautista Medical Center, Inc. | Fernando Velazquez St | Hatillo | 18.4779 | -66.81987 |
| San Juan Bautista Medical Center, Inc. | 39 Carr 14 J | Cayey | 18.11208 | -66.1618 |
| San Juan Bautista Medical Center | Centro Medico Bldg | San Juan | 18.451375 | -66.064526 |
| Office of Criminal Investigations | 525 Ave Fd Roosevelt # 1118 | San Juan | 18.418843 | -66.073233 |
| San Juan Bautista Medical Center, Inc. | M Rivera or Calle La Cruz | Juana Diaz | 18.04794 | -66.50267 |
| San Juan Bautista Medical Center | Munoz Rivera Final | Juncos | 18.22638 | -65.91286 |
| Executive Office of The Commonwealth of Puerto Rico | 401 Ave Ponce De Leon | San Juan | 18.46488 | -66.09595 |
| Puerto Rico Office of The Ombutsman For The Elderly | Ave Ponce De Leon | San Juan | 18.3785 | -66.1647 |
| Administracion De Familias Y Ninos | Ave PNC De Ln Prt De Tr 1 | San Juan | 18.40586 | -66.06383 |
| San Juan Bautista Med Ctr | Isaac Gonzalez St | Utuado | 18.26848 | -66.69789 |
| Municipio De San Juan | De Salud Pabellon 1 Edf 1 St De Salud Pabell | Rio Piedras | 18.40657 | -66.00339 |
| San Juan Bautista Medical Center | 2 Ave Munoz Rivera E | Camuy | 18.48319 | -66.84418 |
| Administracion De Familias Y Ninos | 705 Clle Antnio R Barcelo | Arecibo | 18.4689 | -66.7361 |
| Department of Health | Cerra Street 900 Santurce | San Juan | 18.448737 | -66.08116 |
| San Juan Bautista Medical Center, Inc. | Hospital De Siquiatria | San Juan | 18.451375 | -66.064526 |
| Municipio De Barranquitas | 12 Calle Munoz Rivera | Barranquitas | 18.18372 | -66.30701 |
| San Juan Bautista Medical Center, Inc. | 410 Ave General Valero # 404 | Fajardo | 18.3358 | -65.6532 |
| Ora Southeast Regional Field Office | Centerplex Bldg Ofc 218 | Aguada | 18.378915 | -67.186985 |
| Ora Southeast Regional Field Office | 606 Tito Castro Ave | Ponce | 18.0121 | -66.601 |
| San Juan Bautista Medical Center, Inc. | Turabo Gdns RR 172 | Caguas | 18.2323 | -66.0338 |
| Municipio De Barranquitas | Munoz Rivera St Final | Barranquitas | 18.18912 | -66.31217 |
| San Juan Bautista Medical Center, Inc. | 1 Calle Union | San Juan | 18.445784 | -66.04463 |

| Centers for Disease Control (40) | | | | |
|---|---|---|---|---|
| **Business Name** | **Address** | **City** | **Latitude** | **Longitude** |
| Department of Health | 1411 Ave Ponce De Leon | San Juan | 18.447878 | -66.070727 |
| San Juan Bautista Medical Center | Caimital Bajo Rd 2km # 2 | Aguadilla | 18.420735 | -67.15298 |
| Ora Southeast Regional Field Office | 466 Ave Fernandez Juncos | San Juan | 18.461927 | -66.090939 |

Table 12H: Health and Medical Facility Requirements

| | | FMS | DMAT | IMSURT | DPMU | FACT | NVRT | IRCT | NMRT |
|---|---|---|---|---|---|---|---|---|---|
| **Facilities** | | | | | | | | | |
| Lease/MOU for facility | | X | | | | | | | |
| 40,000 Square Feet | FMS (250 Beds) | X | | | | | | | |
| 10,000 Square Feet | DPMU | | | | X | | | | X |
| 2,500 Square Feet | IRCT/DMAT BoO | | X | X | | X | | X | |
| **Amenities** | | | | | | | | | |
| Refrigerator | Household Size | X | | | | | | | |
| Freezer | Household Size | X | | | X | | | | |
| Washer and Dryer | 5 Each | X | | | | | | | |
| HVAC | Operational | X | | | | | | | |
| Secure Storage | Refrigerated | X | | | | | | | |
| Flooring | Bariatric Holding Capable | X | | | | | | | |
| Hot Water Supply | Hot Water Heater | X | | | | | | | |
| Loading Dock | | X | | | | | | | |
| **Electrical** | | | | | | | | | |
| Commerical Power | 200 Amp/120/240 3 phase | X | | | | | | | |
| Commerical Power | 400 AMP/208 Volt 3 phase | | | | X | | | | |
| Back up Generator | for entire building | X | | | | | | | |
| Electrical Outlets | FMS (40 +) | X | | | | | | | |

| | | FMS | DMAT | IMSURT | DPMU | FACT | NVRT | IRCT | NMRT |
|---|---|---|---|---|---|---|---|---|---|
| **Billeting** | | | | | | | | | |
| 25 Persons | day/night shift | | | | | | X | | |
| 50 Persons | day/night shift | | X | X | | X | | X | X |
| 100 Persons | day/night shift | X | | | X | | | | |
| **Security** | | | | | | | | | |
| Inside of Facility | Access Control | X | | | X | X | | | X |
| Outside of Facility | Perimeter Control | X | | | X | X | | | X |
| **Parking** | | | | | | | | | |
| Staff | | X | X | X | X | X | X | X | X |
| 24' Box Trucks | DMAT (3 per cache) | | X | X | | | X | X | X |
| 53' Reefer Trailers | FMS (4)/DPMU (2) | X | | | X | | | | |
| 53' Reefer Trailers | DPMU Site | | | | X | | | | |
| **Personal Hygiene** | | | | | | | | | |
| Restrooms | 1 per 20 people | X | X | X | X | X | X | X | X |
| Showers | 3 person/hr/24 hrs | X | X | X | | X | X | X | X |
| Handwashing Stations | FMS (16) | X | X | X | X | | | | X |
| Port- A- Johns | 1 per 20 people | X | X | X | X | X | X | X | X |
| **Life Sustaining** | | | | | | | | | |
| Drinking Water (FMS) | 15 L/day/person | X | | | | | | | |
| Drinking Water (Teams)4 L/day/Person | | X | X | X | X | X | X | X | X |
| Water Source | Hose Bib/Fire Hydrant | | X | X | X | | | | X |
| Potable Water (500 Gallon) | If no Hose Bib/Fire Hydrant | | X | X | X | | | | X |
| Ice (FMS) | Up to 3100 lbs/day | X | | | | | | | |
| **Medical Resupply** | | | | | | | | | |
| Prime Vendor Contract | Med Surge | X | X | X | X | | X | | X |

| | | FMS | DMAT | IMSURT | DPMU | FACT | NVRT | IRCT | NMRT |
|---|---|---|---|---|---|---|---|---|---|
| Prime Vendor Contract | Pharmacy | X | X | X | | | X | | X |
| Oxygen, M Cylinder | FMS (25)/DMAT 1 | X | X | | | | | | |
| Oxygen, E Cylinder | FMS (25) | X | | | | | | | |
| Oxygen, D Cylinder | DMAT (6) | | X | X | | | | | |
| **Bio Hazard Removal** | | | | | | | | | |
| Bio Hazard Removal | All Teams | X | X | X | X | | X | | X |
| Gray Water Removal | All Teams | X | X | X | X | | X | | X |
| Black Water Removal | DPMU/NMRT | | | | X | | | | X |
| Gray Water Removal | 500 gallon bladder (DMAT) | | X | X | X | | | | X |
| Trash Removal | 10 yard Dumpster | X | X | X | X | X | | X | X |
| **Food Service** | | | | | | | | | |
| Caterer (Contract) | FMS Only | X | | | | | | | |
| MRE's (Teams Only) | 3 MRE's/day/person | | X | X | X | X | X | X | X |
| Catered Meals (FMS) | 4 meals/day/person | X | | | | | | | |
| **Transportation** | | | | | | | | | |
| 15 Pax Van | | | | | | | X | X | |
| 22' Reefer Truck | | | X | X | | | | | |
| 24' Box Trucks | | | X | X | | | | X | |
| 53' Reefer Trailers | FMS (4)/ DPMU (?) | X | | | X | | | | |
| **Material Handling** | | | | | | | | | |
| 10k Forklift | All Terrain Boom Reach | | X | X | X | | | | X |
| 6k Forklift | All Terrain Tires | | | | X | | | | X |
| 5K Forklift | Numeric Tires | X | | | | | | | |
| Pallet Jack | | X | X | X | X | | | | X |
| Additional Staffing (FMS) | 12-15 additional persons | X | | | | | | | |

| | | FMS | DMAT | IMSURT | DPMU | FACT | NVRT | IRCT | NMRT |
|---|---|---|---|---|---|---|---|---|---|
| **Communications** | | | | | | | | | |
| Radio Frequency | All Teams | X | X | X | X | X | X | X | X |
| Internet Access | All Teams | X | X | X | X | X | X | X | X |
| Phone Lines | FACT (29)/IRCT | | | | | X | | X | |
| FAX Lines | FACT (3)/IRCT | | | | | X | | X | |
| Phones with Headsets | FACT (29) | | | | | X | | | |
| Phones VOIP | IRCT | | | | | | | X | |
| Cell Phones Activated | IRCT/DPMU | | | | X | | X | X | |
| Aircards Activated | All Teams | X | X | X | X | X | X | X | X |
| Toll Free 800 Number | FACT | | | | | X | | | |
| **Adminsitrative Supplies** | | | | | | | | | |
| High Speed Copier | FACT/DPMU | | | | X | X | | | |
| **Fuel (Diesel)** | | | | | | | | | |
| Generator 7 KW (Standard Cache) | 1 Gallon per hour | | X | | | | X | | X |
| Generator 56 KW | 5.5 Gallon per hour | | X | | X | | | | |
| Heater, Western Shelter | 1 Gallon per hour | | X | X | X | | X | | X |
| Heater, Hot Water, Western Shelter | 2 Gallon per hour | | X | X | X | | X | | X |
| Generator, Western Shelter BoO | 4 Gallon per hour | | | X | | | | | |
| **Additional Services** | | | | | | | | | |
| Mortuary Services (FMS) | For 5 remains | X | | | | | | | |
| Linen Contract (FMS) | For 250 Patients/Staff | X | | | | | | | |
| Cleaning Service | FMS | X | | | | | | | |
| EMD Ambulance Service (FMS) | 1 Unit at FMS | X | | | | | | | |
| Adminstrative Supplies | All Teams | X | X | X | X | X | X | X | X |

## SECTION FOUR: HAZARD IDENTIFICATION AND RISK ASSESSMENT



## SECTION FIVE: MITIGATION STRATEGY

# INTRODUCTION

The Federal Emergency Management Agency (FEMA), in implementing the Disaster Mitigation Act of 2000, initiated far-reaching programs and policies that will affect how every level of government approaches emergency management. The legislation reinforces the importance of hazard mitigation planning and assigns certain responsibilities to state governments, which also apply to its territories such as the US Virgin Islands.

## PURPOSE OF THE PLAN

The underlying purpose of the United States Virgin Islands Territorial Hazard Mitigation Plan is to identify strategies and actions that can be taken before a disaster strikes that can greatly reduce the human suffering, damage to property, and the long- term economic impact of natural hazards.

## OVERVIEW OF PLAN UPDATE

States and territories are required to prepare and submit a mitigation plan and then review and update the plan on a three year planning cycle. The Virgin Islands Territorial Emergency Management Agency (VITEMA) has established a Hazard Mitigation Steering Committee as well as three Island Hazard Mitigation Committees - one each on the islands of St. Thomas, St. Croix and St. John - to provide oversight and assist in the Plan Update process.

**Table 1.1** *Summary of the 2014 Plan Update*

| Plan Section | Plan Update |
|---|---|
| Introduction | The introduction has been updated to indicate the purpose of the Plan Update. It also acknowledges key contributors to the Plan Update. |
| Section One - Adoption | An updated adoption letter has been included for signature and adoption of the Plan Update by the Governor of the Virgin Islands. |
| Section Two – Planning Process | This section has been updated to reflect the planning process involved in this Plan Update. This included the description and summary of several meetings with the Hazard Mitigation Steering Committee, the island specific Hazard Mitigation Committees, key stakeholders and public. |
| Section Three – Capability Assessment | This section was updated based on the findings of an assessment to evaluate USVI agency capabilities to implement the various hazard mitigation actions. This consisted of interviews with identified stakeholders to achieve the stated hazard mitigation goals and objectives. New references were included to new planning initiatives including the update of zoning and subdivision legislation. The limited capacity of VITEMA to implement the entire suite of hazard mitigation |

| | |
|---|---|
| | actions in the 2011 Plan was discussed and recommendations made for a more realistic hazard mitigation strategy for the next three year planning cycle. |
| Section Four – Risk Assessment | This section has been updated to reflect changes in the Risk Assessment. It outlines the hazard identification process which includes description of an evaluation process utilized to identify hazards for further study in this Plan Update. It includes a summary of data that has utilized for this Plan Update. This includes inventory information along with data and maps that were developed in the hazard profile. New profile information was added for coastal erosion, which was integrated into the discussion on coastal flooding. New profiles and maps developed for drought, wildfire and rain-induced landslides. This information was used to update the vulnerability assessment. All the data, with the exception of drought information, was compiled to update loss estimates. |
| Section Five – Mitigation Strategy | This section of the Plan Update was based on a detailed review of the goals, objectives and actions contained in the 2011 Plan update. The assessment of the mitigation strategy was based on the findings of the hazard identification and risk assessment and the capability assessment. The mitigation strategy and associated mitigation actions reflected a greater emphasis on conducting planning and hydrologic and hydraulic studies to address areas throughout the islands where inadequate stormwater drainage leads to flooding issues for many neighborhoods.<br><br>Programmatic mitigation actions emphasized the importance of reducing repetitive loss properties throughout the USVI; however, it is particular important for St. Croix where dense clusters of repetitive losses occur in some of the more flood-prone estates. The Island specific mitigation actions were updated and focused on the implementation of hard projects to reduce the risk to hazards identified by the island specific Hazard Mitigation Committees. The repetitive loss strategy was updated and received greater emphasis in the Mitigation Strategy. Many of the mitigation actions for this Plan Update are focused on reducing repetitive flood losses |
| Section Six – Plan Maintenance | A detailed description of the maintenance process is contained in this section of the Plan Update. This includes information concerning the composition of the hazard mitigation committees and the responsibilities of each in the maintenance of this newly updated Plan. |
| Section Seven - Bibliography | This section was updated to reflect new references that were utilized in the Plan Update. It provides an inventory of resources, materials and sources of relevant information utilized in this Plan Update. |

The Plan Update was completed through an extensive planning process. The Virgin Islands Territorial Emergency Management Agency (VITEMA) was designated as the lead agency for the Plan Update. Various USVI departments and authorities actively participated in its development.

The Plan Update describes processes and methods that were utilized in the revise of each section of the Plan. Of primary importance, was interagency participation in the planning process along with extensive public outreach efforts, which included both meetings and public workshops. These efforts led to the Update of the hazard mitigation strategy that seeks to implement both programmatic as well as island specific actions for the US Virgin Islands.

This Update, like its predecessor, seeks to serve a number of purposes, including:

- Promote interagency coordination of programs, policies and practices regarding hazard mitigation opportunities;
- Enhance public awareness and understanding of hazards that affect communities and actions the public can take to make themselves safer;
- Identify, evaluate and prioritize a range of mitigation actions that are specific to St. Thomas, St. Croix, and St. John;
- Comply with federal program requirements regarding eligibility for disaster recovery and mitigation grant funding.

This Update was prepared to meet all applicable state mitigation plan requirements as outlined in the Interim Final Rule for DMA 2000, published in the Federal Register on February 26, 2002, at 44 CFR Part 201 and 206.

VITEMA gratefully acknowledges the efforts of the departmental representatives for their participation as members of the Hazard Mitigation Committees (HMC) on each major island, along with the numerous private sector and community representatives who gave their time and support to this undertaking. The complete list of Committee members is included in Section 2.0

## DEFINITIONS, ACRONYMS AND ABBREVIATIONS

This section provides the definitions of all acronyms and abbreviations used in the document.

| | |
|---|---|
| ARC | American Red Cross |
| BCA | Benefit Cost Area |
| BCR | Benefit Cost Ratio |
| BEA | Bureau of Economic Analysis |
| BFE | Base Flood Elevation |
| CAD | Caribbean Area Division |
| CDBG | Community Development Block Grant |
| CFR | Code of Federal Regulations |
| CLWUP | Comprehensive Land and Water Use Plan |
| CRBA | Coastal Resource Barrier Act |
| DOA | Department of Agriculture |
| DMA 2000 | Disaster Mitigation Act of 2000 |
| DPW | Department of Public Works |
| DHS | Department of Homeland Security |
| DPNR | Department of Planning and Natural Resources |
| FEMA | Federal Emergency Management Agency |
| FHBM | Flood Hazard Boundary Map |
| DFIRM | Digital Flood Insurance Rate Map |
| FIS | Flood Insurance Study |
| FMA | Flood Mitigation Assistance Program |
| FMV | Fair Market Value |
| GAR | Governor's Authorized Representative for Hazard Mitigation |
| GIS | Geographic Information System |
| GDP | Gross Domestic Product |
| HAZUS | Hazards United States |
| HMGP | Hazard Mitigation Grant Program |
| HUD | Housing and Urban Development |
| HPR | Department of Housing, Parks and Recreation |
| HMTAP | Hazard Mitigation Technical Assistance Program |
| HMC | Hazard Mitigation Committee |
| NEPA | National Environmental Policy Act |
| NFIA | National Flood Insurance Act |
| JFLH | Juan F. Luis Hospital |
| OMB | Office of Management and Budget |
| NOAA | National Oceanic and Atmospheric Administration |
| PDM | Pre-Disaster Mitigation Program |
| SRMC | Schneider Regional Medical Center |
| SLOSH | Sea, Lake and Overland Surges from Hurricanes |

| | |
|---|---|
| STAPLEE | Social, Technical, Administrative, Political, Legal, Economic and Environmental review criteria |
| VIFD | Virgin Islands Fire Department |
| VIPD | Virgin Islands Police Department |
| WPA | Water and Power Authority |

This section describes the plan adoption process utilized in the Update of the US Virgin Islands Territorial Hazard Mitigation Plan.

## 1.1 IFR REQUIREMENTS FOR PLAN ADOPTION

DMA 2000 compliant Standard State Hazard Mitigation Plans must be formally adopted by the appropriate elected official(s). In the US Virgin Islands, the Governor has the authority to act on behalf of the Territory in this regard.

The IFR contains two specific requirements relative to the adoption of the Plan by the US Virgin Islands:

- **Requirement §201.4(c)(6):** "The plan must be formally adopted by the State prior to submittal to [FEMA] for final review and approval."
- **Requirement §201.4(c)(7):** "The plan must include assurances that the State will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d)."

## 1.2 PLAN ADOPTION BY THE GOVERNOR OF UNITED STATES VIRGIN ISLANDS

Adoption of the Virgin Islands Territorial Hazard Mitigation Plan by the Governor of the US Virgin Islands affirms the commitment of the Territory to pursue the activities and actions identified in the Plan.

Following this page is a formal letter of adoption on behalf of the US Virgin Islands, signed by Governor deJongh on July 10, 2014, which incorporates and satisfies both IFR requirements (§201.4(c)(6) and §201.4(c)(7)).

THE UNITED STATES VIRGIN ISLANDS
OFFICE OF THE GOVERNOR
GOVERNMENT HOUSE
Charlotte Amalie, V.I. 00802
340-774-0001

July 10, 2014

Mr. Jerome Hatfield
Regional Administrator
Federal Emergency Management Agency, Region II
FEMA Region II
26 Federal Plaza
New York, NY 10278-0002

**RE: Virgin Islands Territorial Hazard Mitigation Plan Update (2014)**

Dear Administrator Hatfield:

It is with pleasure that the Government of the United States Virgin Islands submits the Virgin Islands Territorial Hazard Mitigation Plan Update for your review and approval. The Plan Update was prepared in response to the Standard State Hazard Mitigation Plan Update requirements of the Disaster Mitigation Act of 2000 (44 CFR 201.4). Upon the recommendations of the Virgin Islands Territorial Emergency Management Agency (VITEMA), this letter represents my formal adoption of this plan as the blueprint for future actions to reduce the devastating impact of natural disasters on our residents, property owners and commercial enterprises.

The actions included in this Plan Update reflect strategies that we can undertake to reduce the adverse effects of major hazards that impact our Territory. These strategies address hazards such as hurricanes, coastal and inland flooding, earthquakes, drought, wildfire, tsunamis, and ran-induced landslides. The Plan Update follows our previous plan that was submitted in 2011 and outlines recommended actions ranging from programmatic measures that seek to incorporate enhanced mitigation practices within our governmental agencies; to specific actions that focus on implementing meaningful hazard mitigation projects for each island.

I certify that the Territory will comply with all applicable statues and regulations in effect with respect to the periods for which it receives grant funding. We will also amend the plan, whenever necessary, to incorporate changes in state or federal laws and statues as required in 44 CFR 1.11 (d).

***Mr. Jerome Hatfield***
***Regional Administrator, FEMA Region II***
***July 10, 2014***
***Page 2***

The efforts of your staff within the Caribbean Area Division (CAD) in working with VITEMA to develop this Plan Update are greatly appreciated. It is my desire to continue to work in a close relationship as partners with the Federal Emergency Management Agency (FEMA) as we continue to mitigate the losses associated with the hazards that affect our Territory.

I look forward to receiving approval of our Plan Update by your agency so we may continue to mitigate the potential impact of future losses due to all hazards. If you or your staff have any comments, questions or concerns please contact VITEMA Director Elton Lewis at Elton.lewis@vitema.vi.gov to (340) 773-2244 or Mr. Haldor Farquhar, Territorial Hazard Mitigation Officer, at haldor.farquhar@vitema.vi.gov or (340) 774-2244. Again, thank you for your continued support.

Sincerely,

John P. de Jongh, Jr.
Governor

pc: Alejandro De La Campa, Director, Caribbean Area Division
Elton Lewis, VITEMA Director
Richard T. Evangelista, Esq., Alternate Governor's Authorized Representative

This section is presented in the following four subsections:

- 2.1 IFR Requirement for Planning Process,
- 2.2 Description of the Planning Process,
- 2.3 Coordination among Government Agencies, and
- 2.4 Integration with other Planning Efforts

## 2.1 IFR REQUIREMENT FOR PLANNING PROCESS

IFR §201.4(b) states that "[a]n effective planning process is essential in developing and maintaining a good plan." The IFR continues to include three specific requirements for the process of developing Standard State Hazard Mitigation Plans:

- **Documentation of the Planning Process** per **Requirement §201.4(c)(1):** "[The State plan must include a] description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated."
- **Coordination Among Agencies** per **Requirement §201.4(b): "**The [State] mitigation planning process should include coordination with other State agencies, appropriate Federal agencies, interested groups,…"
- **Program Integration** per **Requirement §201.4(b): "**[The State mitigation planning process should] be integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives."

# 2.2 DESCRIPTION OF THE PLANNING PROCESS

## 2.2.1 ANALYSIS OF PLAN

For the purposes of the Plan Update, the newly established Hazard Mitigation Steering Committee (Refer to Section 2.3.2 below) led the Plan Update effort. The 2011 Plan indicated that the Plan would undergo annual evaluations and that VITEMA, and then established three (3) Hazard Mitigation and Evaluation Committees (HMEC) for each island and would initiate the evaluations by contacting agencies identified as responsible parties for the implementation of Mitigation Action. No annual meetings has taken place between 2011 and 2014 to review and update the Plan as outlined in the Plan Maintenance Section of the 2011 Plan Update.

Justification as to reasons why there were no annual meetings was not made available at the time of this Plan Update; however, new personnel involved VITEMA have been engaged in this process and have hired the consultant team to work with VITEMA on an annual basis (contracted for 2015) to document the status of the implementation of Mitigation Actions. This process has been defined during subsequent meetings of the Hazard Mitigation Steering Committee. The changes that have been made to the 2014 Plan Update are as follows:

**Section One – Introduction and Adoption**

- Add a table or statement of what has changed in the update of Plan
- Ensure that Territorial assurances are in the adoption letter, particularly related to the Plan maintenance process

**Section Two – Planning Process**

- Explain Plan Update process, invitations, community meetings (include announcements; specify dates, place, and attendees of meetings).
- Summarize findings of meetings
- Updated listing of participants and key stakeholders that were involved in the planning process, meeting information, coordination among government agencies, and integration with other planning efforts.
- Key change is that the island hazard mitigation committees as referenced in previous plans are now called hazard mitigation and evaluation committees, persons identified for each island, and will play a role in the annual maintenance process.

**Section Three - Capability Assessment**

- Update Virgin Islands policies, programs and capabilities related to pre- and post-disaster hazard mitigation;
- Update Mitigation Project Status;
- Clarify Administration of Mitigation grant funds;
- Update Federal Funding Sources, particularly new Hazard Mitigation Assistance Unified Guidance;
- Elimination of the Severe and Repetitive Loss Claim grant programs;
- Changes to the cost share provisions of PDM, FMA, and HMGP grant programs;
- Update VI funding and responsibilities matrix, as appropriate;
- Update Regulatory Compliance Table update, as appropriate.

- Update Recommendations Table update, as appropriate

**Section Four – Hazard Identification and Risk Assessment**

- Explain how the HIRA was reviewed, and explain if process has changed
- Update Hazard Identification by explaining how it was reviewed, and explain why hazards were added or removed.
- Note the addition and integration of four recommended hazards: coastal erosion (integrated with coastal flooding), wildfire, drought and rain-induced landslides

*Coastal Flooding and Erosion*

- No Change, No new events reported or documented

*Earthquake*

- Update history based on information from the Puerto Rico Seismic Network for earthquakes with a Magnitude of 4.0 or above;
- Update of new seismic hazard map with building code provisions table.

*Tsunami*

- New Tsunami maps were utilized in hazard profile.
- Update hazard profile accordingly

*Wildfire*

- Update Hazard Identification and Profile
- Conduct loss estimates for future events based on review of data from NCDC.

Drought

- Update Hazard Identification and Profile
- Conduct loss estimates for future events based on review of data from NCDC

Rain-Induced Landslide

- No Change, No new events reported or documented
- Update Hazard Identification and Profile
- Develop Hazard Susceptibility Map to provide an understanding of spatial extent of hazard
- Describe and/or list historic events to understand frequency of the hazard in the USVI
- Update Vulnerability Assessment
- Conduct loss estimates for future events.

*Inventory of Assets*

- Describe if the 10 model building types have changed for this Plan Update.
- Update building and Critical Facility values based on rate of inflation, construction price index and compounded inflation factor.
- Update Population figures based on Annual Growth Rate, projected; as to figures derived from the 2010 census information for the USVI is not available.

*Vulnerability Assessment*

- Based the above, update population data and update social impacts table
- Based on the above, update exposure and vulnerability tables.
- Conduct spatial overlay and queries and update social impacts sections for wildfire, drought and rain-induced landslides
- Conduct spatial overlays and queries and update exposure and vulnerability tables for wildfire, drought and rain-induced landslides

**Section Five - Mitigation Strategy**

- Review goals / objectives, explain how they were reviewed, and explain any changes to goals or objectives
- Review previous programmatic mitigation strategy and explain progress made on each action, if any
- Review previous island specific mitigation strategy and explain progress made on each action, if any
- Review and reference previous repetitive loss mitigation strategy and explain progress made on each action, if any
- When prioritizing Actions for the Plan Update, explain if STAPLEE review came before or after the actions were put into the mitigation strategy

**Section Six - Plan Maintenance**

- Describe if any monitoring was actually done since last Plan Update
- Explain if the approach has been successful, and whether, it should be used in this Plan Update.
- Explain why a new approach was chosen
- Explain that there were no annual evaluations of the existing Plan;
- Explain changes to membership of the Hazard Mitigation Steering Committee, and how it differs from the Hazard Mitigation Monitoring and Evaluation Committee; justify or explain changes that occurred
- Explain the Public Notification Process that was used to initiate the plan update; explain when and how notices were issued
- Describe Annual Meetings and Reports
- Explain or describe process for monitoring project closeouts, add to whom quarterly reports are sent
- Describe findings of 3-year evaluations and updates to the plan;
    - In the update, add a schedule for evaluation activities, explain responsible parties
    - In the update, provide a schedule showing how the next update process will be implemented
- Describe the Steering Committee; explain who is on this committee, if it is an effective approach, and if the approach will continue to be used or will be modified

The Hazard Mitigation Steering Committee reviewed all of the above listed comments with the CIPA consultant team. Each section of the Plan was reviewed utilizing a completed FEMA crosswalk.

## 2.2.2 PLAN UPDATE

As noted, the Disaster Mitigation Act of 2000 (DMA 2000) provides a strong incentive for the development of a Standard State Hazard Mitigation Plan. The planning process began in 2004 and led to adoption of the Virgin Islands Territorial Hazard Mitigation Plan by the Governor and approval by the Federal Emergency Management Agency (FEMA) Region II on April 28, 2005.

The law stipulates that the Plan will be updated and re-submitted to FEMA for re-approval every three (3) years, as required by law. It is the understanding of the planning team, based on (44CFR Part 201).
In April of 2014, FEMA promulgated a Final Rule that changed the frequency of Mitigation Plan Updates (44CRR Part 201). The Final Rule extends the Plan Update requirement for States and Territories from 3 to 5 years.

The process used to update this Plan in accordance with the IFR requirement was formally initiated by VITEMA during a special meeting in April, 2014. The work undertaken consisted of updating all sections of the 2011 Plan Update. This was done by using the best available data and methodologies for a target of June 2014 for FEMA final approval.

The process of planning and review of the Plan Update is detailed in this section. The method utilized includes the appraisal and expansion of the 2011 Plan. In accomplishing the objective of the Plan Update, several areas of importance were addressed. The following summary identifies the process used to revise and update each section of the Plan.

- **Introduction**: The introduction presents a summary of the purpose of the Plan Update. It also acknowledges the primary contributors to the Plan Update. It provides information as to the changes made from the 2011 Plan Update. It also includes a list of acronyms.

- **Section One – Adoption**: This section of the Plan Update includes an adoption letter for signature by the Governor of the US Virgin Islands which includes agreement with the Plan Update and assurances that the Plan Update will be implemented by the various agencies of the government.

- **Section Two – Planning Process**: This section has been updated to reflect the participants involved in this Plan Update. The planning process for the Plan Update was similar to that employed for the 2005, 2008 and 2011 Plan Updates. Meetings of the Hazard Mitigation Steering Committee have been held. The meetings for three Island Hazard Mitigation Monitoring and Evaluation Committees, established for each major island, have been documented as well as other key stakeholders involved in the planning process.

- **Section Three – Capability Assessment**: The assessment of the capability of the US Virgin Islands Government, all programs and policies relating to hazard mitigation were reviewed. Recommendations in regard to an analysis of mitigation actions were updated. Progress since the adoption of the 2011 Plan Update has been noted. Technical and financial capabilities are the most crucial area of concern and have stymied the implementation of actions that were identified in the previous plan. Fiscal uncertainty, adequate staffing and the availability of necessary resources remain as hindrances to the full implementation of hazard mitigation in the Territory, especially in VITEMA. Assistance through federal funding sources and the territorial responsibilities were updated.

- **Section Four – Risk Assessment**: The Plan Update utilizes data furnished by the Office of the Lieutenant Governor to VITEMA in 2014. It has been updated in this Plan Update to determine and the inventory of structures and their present replacement cost. The inventory developed is more reliable than that previously available as it utilized compounded inflation rates, to the most current year 2013. The Plan Update reflects general increase in the number of buildings and increase in overall total value since the 2011 Plan Update. Using this data, an island specific vulnerability assessment was updated for each of the identified hazards. The hazards included in this Plan update include: hurricane winds, riverine flooding, coastal flooding, earthquake and tsunami, wildfire, drought and rain-induced landslide. It is necessary to note that the profile for Tsunami has been updated to include new mapping data developed by NOAA, and the coastal flooding profile has been updated to include the potential impacts that Climate Change, and specifically sea-level rise, so as to understand on coastal flooding and secondary coastal hazards such as coastal erosion.

- **Section Five – Mitigation Strategy**: This section of the Plan Update presents the goals, objectives and mitigation actions necessary to implement the Territorial Hazard Mitigation Strategy. The goals and objectives in the 2014Plan Update have not changed from those highlighted in the 2011 Plan; however, The Island Hazard Mitigation Committees approved postponing any mitigation actions associated with *Goal 2: Integrate Hazard Mitigation and Sustainable Development principles into ongoing Government operations and long term Planning* because of human resources and operational budget constraints at VITEMA, DPNR and DPW. The strategies contained in the 2011 Plan Update were reviewed and mitigation actions undertaken since the 2011 Plan Update was formally approved. Viable strategies were prioritized according to urgency and evaluated according to economic and social impact. This ranking is detailed in Appendix G (STAPLEE). A comparison between the mitigation actions contained in the 2011 Plan and this Plan Update revealed a more actions focused reducing on severe repetitive loss properties and planning projects that provide needed data to address flooding issues, given the lack of data to participate fully in a Benefit Cost Analysis and due to the limited capacity at VITEMA and other agencies. The strategies developed by the various hazard mitigation committees show a congruency with the Risk Assessment.

- **Section Six – Plan Maintenance**: The maintenance process is detailed in this section of the Plan Update. It explains the changes made to maintenance and implementation of mitigation strategies when compared to those in the 2011 Plan. Even though the membership of the committees has changed, the present membership demonstrates a high degree of dedication and commitment to implement and accomplish a more realistic hazard mitigation strategy.

- **Section Seven – Bibliography**: The bibliography of the Plan Update provides an inventory of resource material, sources of pertinent information and new references that were used in the Plan Update.

The Plan Update represents the efforts and contributions of several governmental agencies and other stakeholders. The 2014 Plan Update was reviewed and analyzed resulting in pertinent modifications. With the incorporation of information concerning climate change, which provides an overview of how susceptibility will increase or decrease, the territory's profile and understanding of natural hazards is more complete. Mitigation strategies were developed and prioritized to address present data concerns. The 2011 Plan along with the recent data formed the foundation for this Plan Update. The Hazard Mitigation Steering

Committee and the island specific Hazard Mitigation Committees have been newly formulated and have expressed a commitment to implementing an effective hazard mitigation program in the USVI, particularly those priority mitigation actions included in this Plan Update.

### 2.2.3 PLANNING TEAM

During the development of the 2014 Plan Update, VITEMA established a Hazard Mitigation Steering Committee with the charge of the Plan Update. However, for this Plan Update, this new committee was comprised only of VITEMA staff members. Similar to the previous plan update, this Committee had oversight of the Plan Update consultancy, and consequently remained intact for the plan maintenance and monitoring process outlined in Section 6.0 of this Plan. This Committee is responsible for the implementation of actions identified in the Plan Update. FEMA, which played an advisory role on the Hazard Mitigation Steering Committee, emphasized the importance of monitoring and evaluation, and the importance of capturing historic information for the approval of hazard mitigation projects, especially flood drainage construction projects.

The Virgin Islands Territorial Hazard Mitigation Officer, Mr. Haldor Farquhar, has organized the Hazard Mitigation Steering Committee, and will chair the Committee. The members of the Hazard Mitigation Steering Committee are noted below in Table 2.1.

**TABLE 2.1** ***Hazard Mitigation Steering Committee***

| Name | Agency/ Department |
|---|---|
| Haldor Farquhar*** | VITEMA |
| Austin Callwood | VITEMA |
| Joanne White | VITEMA |
| Malinda Vigilant | VITEMA |
| Renata Christian | VITEMA |
| Debra Henneman-Smith | VITEMA |
| Oliver Morton | VITEMA |
| *** Chairman | |

VITEMA feels that the development of an effective state-level Hazard Mitigation Plan requires inclusion in the planning process of representatives from a wide-range of public, private, and non-profit sectors. Clear lines of communication with the active participants and the general public are necessary. For the 2014 Plan Update, VITEMA also re-established three Committees: the St. Thomas Hazard Mitigation Monitoring and Evaluation Committee (covering St. Thomas and Water Island), the St. John Hazard Mitigation Monitoring and Evaluation Committee and the St. Croix Hazard Mitigation Monitoring and Evaluation Committee.

The purpose of the Hazard Mitigation Committees was three-fold:

(1) to provide oversight to the VITEMA contractor during the Plan Update;

(2) to contribute to the development of a revised mitigation strategy; and

(3) to identify and prioritize mitigation actions that were specific to each island.

The members of each Island Hazard Mitigation Committee members are outlined in the tables below:

**TABLE 2.2 Hazard Mitigation Monitoring and Evaluation Committee, *St. Thomas***

| | Hazard Mitigation Monitoring and Evaluation Committee | | |
|---|---|---|---|
| **St. Thomas** | Tom Mc Coy | Rachael Ackley | Vince Roberts |
| | Elton George | Alex Bruney | Byron Todman |
| | Bliss Bully | Daryl George | Stacy George |
| | Nicole Turner | Vance Pinney | Austin Callwood |
| | Joanne White | Haldor Farquhar | |

**TABLE 2.3Hazard Mitigation Monitoring and Evaluation Committee, *St. Croix***

| | Hazard Mitigation Monitoring and Evaluation Committee | | |
|---|---|---|---|
| **St. Croix** | Jayson Parrilla | Amos King | Malika Felix |
| | Dexter Hypolite | Ellerton Maynard | Barbara Walker |
| | Tawana Nicholas | Akila Toussaint | Eran Flemming |
| | Marla Matthew | David Sweeney | Raphael Joseph |
| | Malinda Messer | Haldor Farquhar | Leonard Gumbs |
| | | | Joanne White |

**TABLE 2.4 *Hazard Mitigation Committee, St. John***

| | Hazard Mitigation Monitoring and Evaluation Committee | | |
|---|---|---|---|
| **St. John** | David Rosa | Sharon Coldren | Dale Brathwaite |
| | Derron Jordon | Attlee Connor | Avery Christian |
| | Linda Williams | Leonard Gumbs | |
| | Joanne White | Haldor Farquhar | |

## 2.2.4 MEETINGS AND WORKSHOPS

The Hazard Mitigation Steering Committee and Islands Hazard Mitigation Committees met on ten (10) separate occasions for the Plan Update. The purpose and outcomes of the meetings are included in the matrix provided in Sections 2.2.3.1 and 2.2.3.2.

### 2.2.4.1 Hazard Mitigation Steering Committee Meetings

The Hazard Mitigation Steering Committee met on ten (10) separate occasions while developing the 2014 Plan Update.

**TABLE 2.5** ***Hazard Mitigation Steering Committee Meetings***

| # | Date/Place | Attendance | Purpose/Outcomes |
|---|---|---|---|
| 1 | 1/11/2014<br>VITEMA Headquarters | VITEMA Mitigation Staff, FEMA | Plan Organization |
| 2 | 1/14/2014<br>VITEMA Headquarters | VITEMA Mitigation Staff, FEMA | Planning Process |
| 3 | 1/21/2014 St. John EOC | VITEMA EOC St. John | Planning Process |
| 4 | 3/11/2014, VITEMA Headquarters; St. Croix ECO, St. John EOC, | VITEMA Mitigation and Evaluation Committee. All islands | Planning Process, identification of new projects, discussion for all islands. |
| 5 | 3/19/2014 VITEMA Headquarters; St. Croix ECO, St. John EOC, | VITEMA Mitigation and Evaluation Committee, All islands | Planning Process, identification of new projects, discussion for all islands. |
| 6 | 4/22/2014, VITEMA Headquarters | VITEMA Steering Committee | Review of projects and status of plan |
| 7 | 4/24/2014, VITEMA Headquarters | VITEMA Steering Committee, CIPA | Contractor hired, Contractor provided overview of planning process related to the update of the Territory's Hazard Mitigation Plan according to DMA 2000.<br><br>Consultant discussed key points: timing for plan update, mitigation strategy simplification based on capabilities of territorial agencies, and hazards of concern. Planning process and scheduled public workshop meetings; mitigation strategy updates needed for goals, objectives and actions |
| 8 | May 6, 2014, VITEMA Headquarters | VITEMA Steering Committee, CIPA | New FEMA funding framework discussed, particularly HMA Unified Guidance and the National Disaster recovery Framework.<br><br>Plan Update discussed with FEMA and VITEMA and insane time schedule established for submittal of plan for simultaneous FEMA, VITEMA and public review on May 23, 2014. |
| 9 | 5/12/2014/ VITEMA Headquarters | VITEMA Mitigation Staff, Director | Update as to status of the Plan and newly established schedule for Plan Delivery. |
| 10 | 5/22/2014 VITEMA Headquarters | VITEMA Mitigation Staff, CIPA | Review of hazard mitigation strategy and staple, review status of plan update schedule. |

Sign-in sheets from these workshops are available in Appendix A of this Plan.

## 2.2.4.2 Hazard Mitigation Monitoring and Evaluation Committee Meetings

In this Plan Update, VITEMA utilized its state of the art teleconference facility at the VITEMA headquarters building in St. Thomas. Each of the Island Hazard Mitigation Committees was teleconferenced in to the meeting on six (6) separate occasions to contribute to the current update of the Plan (2014):

**TABLE 2.6** ***Hazard Mitigation Monitoring and Evaluation Committee Meetings***

| # | Date/Place | Attendance | Purpose/Outcomes |
|---|---|---|---|
| 1 | 3/11/2014 VITEMA Headquarters | Government Officials, VITEMA Mitigation Staff | Planning process orientation |
| 2 | 3/13/2014 VITEMA Headquarters | Government Officials, VITEMA Mitigation Staff | Planning process orientation |
| 3 | 4/1/2014 VITEMA Headquarters | Government Officials, VITEMA Mitigation Staff | Mitigation action submittal/ review from government agencies |
| 4 | 5/13/2014 Emerald Beach | VITEMA Mitigation Staff, Hazard Mitigation Committees (St. Thomas), CIPA and FEMA | Review of preliminary HIRA results, and Review of evaluation of new island specific mitigation actions. |
| 5 | 5/14/2014 St. John EOC | VITEMA Mitigation Staff, Hazard Mitigation Committees (St. John), CIPA and FEMA | Review of preliminary HIRA results, and Review of evaluation of new island specific mitigation actions. |
| 6 | 5/15/2014 Gertrude's, St. Croix | VITEMA Mitigation Staff, Hazard Mitigation Committees (St. Croix), CIPA and FEMA | Review of preliminary HIRA results, and Review of evaluation of new island specific mitigation actions. |

While sign-in sheets are evidenced in Appendix A for the meetings listed in the tables above, it is necessary to note that several additional meetings took place in the territory for the update of the 2014 Plan most notably teleconferences led by VITEMA for the coordination of the planning process.

## 2.2.3.3 Public Involvement and Outreach

### 2.2.4.3.1 Public Notification

For the Plan Update, VITEMA's public notification campaign was led by Ms. Christina Lett, VITEMA Public Relations Officer. The public was notified through the media and press releases. Specific information about the project, including mitigation action descriptions were also disseminated to the public through the three Island Hazard Mitigation Monitoring and Evaluation Committee.

Notification of the VITEMA community meetings were published in the major newspapers (VI Source, St. John Trade Winds). The public meetings were also announced on radio shows. Committee members were emailed and kept posted of project progress, including the completion of major milestones. Draft sections of the plan were mailed to the committee members for review and comment.

Public Notices were also prepared following the preparation of the draft Plan encouraging the public to review and comment on the document which was made available by VITEMA on its website (see VITEMA web site posting on May 23, 2014). See Appendix B for documentation of public notification.

### 2.2.4.3.2 Public Workshops

For the Plan Update, a total of three (3) public information workshops were held in the Territory. These workshops were held on St. Thomas on May 13, 2014, St. John on May 14, 2014 and St. Croix on May 15, 2014. Sign-in sheets from these workshops are available in Appendix A of this Plan. The public informational workshops were held at 5:30 pm.

For this Plan Update, only one (1) public workshop was held on each island. One (1) public informational meeting was deemed to be sufficient as it provided the public with an overview of the planning process, an overview of the DMA 2000 criteria, HMA Unified Guidance, National Disaster Recovery Framework, the results of the HIRA and a preliminary listing of hazard mitigation actions, both programmatic and island specific. Then each workshop was open to participants to express any and all concerns regarding the planning process, natural hazards and hazard mitigation strategy.

These meetings, as in the previous Plan Update, proved to be valuable and provided insight into the desires and concerns of the community related to hazard mitigation actions. The discussions and recommendations of the community meeting provided insight for the identification of Hazard Mitigation Actions included in this Plan Update. A "Cardstorming" session was held, where participants were encouraged to list three personal concerns related to hazard mitigation. This facilitated an interactive consensus-building exercise that provided important feedback from individuals who have been directly affected by recent disasters.

These public information workshops allowed all participants the opportunity to express their issues, concerns and recommendations with regard to disaster recovery, natural hazards and reoccurring damages in their communities. This met the criteria of providing the public an opportunity to comment during drafting.

During the meeting, VITEMA agreed to make the draft Plan available to the public before final approval. This will be done by email notification and via a global press release which will indicate its location on the World Wide Web via a URL. Again, this process is consistent with planning criteria, which does not require formal hearing and that plan comments can be harvested in numerous ways including website participation. VITEMA received public comments during the period in which that plan was posted on its web site (May 25-June 11, 2014). Public comments received from government agencies and private citizens and organizations have been incorporated into the Final Plan Update for 2014.

#### *St. Thomas Information Workshop/Town Hall Meeting*

The St. Thomas Public Information Workshop was held at the Emerald Beach Resort on May 13, 2014. There were ten (14) participants in the workshop, including residents and representatives of community associations/ businesses. Following are specific concerns identified by participants during this community workshop:

- Water Island Ferry Dock at "Philips Landing" experiences periodic flooding in the main turn around area, which can remain flooded for a week or longer with depths around 2 feet near the center.

- Honeymoon Beach at Druif Bay at the western end of Water Island; flooding blocks passage and covers road with as much as 3 feet on the beach road, which takes 3 weeks to drain.
- Flamingo Bay Upper Road – main access to rescue vehicles and fire station. Road is in very bad condition. Very large potholes and washes out in certain areas after heavy rain.

- Honeymoon Beach at Druif Bay. Upper Main Road; roadside guts on North and South roads do not drain properly; drains are blocked with sludge and debris.

- Ivanna Eudora Kean High School. Water seeps through block wall and floods classrooms.

- Hurricane Shutters are needed for Garden Street Career & Tech Center

- Evelyn Williams School - Main structural system of the facility needs to be addressed.

- Pearl & Larsen School. Roof needs to be addressed for hurricane winds (retrofit).

- Dam on Weymouth Ryhmer Highway needs to be cleaned.

- Black Point Road needs a retaining wall to prevent large rocks from rolling in the road during rains.

- Department of Public Works need to improve drainage along Route 3, especially in front of Banco Popular (Main Branch) to Cancryn School to alleviate flooding in main thoroughfare.

- Address flooding on main roadway in front of Tutu Park Mall

- Northside Village Area – severe flooding and landsliding during heavy rains.

- DPW needs to procure appropriate equipment that will facilitate the cleaning of small guts as this seems to be a recurring problem throughout the island.

- Flooding in Estate Nadir by the St. Thomas Abattoir and race track (Bovoni road)

- A thorough inspection of waste water system should be conducted with focus to separate waste water collection system and storm water drainage to reduce and correct infiltration issues.

- Development of satellite sites to handle debris after storm events (Convenience Center).

- Still flooding problems at the St. Thomas Tutu Fire Station, which can be alleviated by a simple culvert.
- Smith Bay needs a drainage study as it is in a basin and easily floods.
- Human Services building on First Street; that area floods and has a shelter there.
- Flooding of VITEMA entrance due to poor drainage in front of building that needs to be improved to prevent intrusion of storm water runoff from parking lot into the building.
- Structural retrofit of critical facilities used for sheltering on St. Thomas, including: Lockhart School, Bertha Bochulte Middle School, and Humans Services Head Start.
- Water Catchment at Hospital Ground, near the Danish Burial Grounds. Following severe storm events, the water in the catchment basin rises, and then drains through a gut within the burial ground. Storm water flows, often at least 2 feet in depth, leads to damage on the road, preventing access and egress and continual road damage that needs to be maintained. Elderly and persons with disabilities live in the area and cannot evacuate following severe storm events.
- Concern about WAPA power plant – what would happen if STT was faced with a tsunami event that took out the power plant.
- Would like to see road repair and guts and drainage improvements by Al Mc Bean Park. Water and rocks settle on the main road from storm water flowing down from the surrounding hill.
- Frenchman Bay Estate. The main road on Frenchman Bay is failing due to a major road slippage. The roadway is cracked and with a 40 feet slab of roadway hanging over a private property. This is a hazard to property owners and those traveling down the road. Emergency vehicles have difficulty traversing the road. Rain causes rock and dirt land slippage onto the road and adjacent private property. Engineering study is needed to develop a cost-effective solution to this problem.
- Wintberg Estate public road is being undermined by erosion. The road is higher than the retaining wall of private homes.
- At the Blue Water Bible College there is a need to retrofit the electrical service so that all 3 main buildings can be connected to the same power back-up generator.

### *St. John Public Information Workshop/Town Hall Meeting*

The St. John community workshop was conducted at the Julius Sprauve School on May 14, 2014. There were nine (9) participants in the workshop, including residents and representatives of community associations/ businesses. Following are specific concerns identified by participants during this community workshop:

- Cruz Bay Fire Station. Flooding from new construction road. Extra drain needs to be put in place at the top of the road.

- Functional replacement of the Fire Station in Coral Bay due to flooding and building sinking because it is too close to the ocean.
- St John local roads need to be inspected so as to identify areas for culvert replacement/improvement, especially enlarging existing rusted galvanized steel at least one diameter size.

- Slope stabilization on both the high and low sides of watershed in coral bay is required to identify Best Management Practices (BMPs) to reduce erosion and sedimentation of culverts and guts.

- Seek agency in territory to conduct a Hydrologic and hydraulic (H&H) study of Coral Bay drainage basins and determine engineering solutions for current and projected residential development so as to address outlet locations, natural guts, and the need to adjust storm water flows.

- Expand repetitive loss strategy by developing phased approach to resolving clusters repetitive loss properties on St. John and throughout the territory.

### *St. Croix Public Information Workshop/Town Hall Meeting*

The St. Croix Public Workshop was conducted at Gertrude's on May 15, 2014. There were eight (8) participants in the workshop, including residents and representatives of community associations/ businesses. Following are specific concerns identified by participants during this community workshop:

- Pursue a shutter project for windows for Lew Muckle School (St. Croix) as the windows are quite old.

- Address the corroded light poles at Complex High School (St. Croix).

- Southern Coast at Container Port represents a Tsunami hazard and the Tsunami warning siren not heard in this portion of St. Croix.

- Coastal Interceptor should be relocated in the Little Princess area, approximately 2000 feet of a submerged sewer line needs to be replaced to reduce sewage spillage and health hazards.

- Clean out and increase the capacity of the Frederiksted Gut, to alleviate flooding near the Ball Park.

- Separation of storm and sanitary sewers in the Christiansted Collection System.

- Flood prevention upgrades for all pumping stations on the island; including elevating and grading access road, and drainage improvements to nearby gut to reduce flooding of stations.

- Initiate a project to have St Croix become eligible for reduced flood insurance costs by developing a strategy and action plan for improving the flood management program on the Island so that we can participate in the community rating system. This effort would include an outreach strategy and series of community meetings on the NFIP program, First living floor and base flood elevation determinations, LOMARs, and other flood insurance questions and concerns.

- Installation of a culvert and other drainage improvements in Estate Rust-up-Twist. A hydrological study of the drainage basin will be required to provide factual basis for upgrades.

- La Grange Gut still remains to be a problem area where there was a recent fatality from flooding. A retention pond needs to be constructed upstream to lessen the velocity of storm waters.

- Old Castle Coakley, south of the Red Cross keeps flooding due to storm water runoff coming from Zion farm community which require swales to be constituted to curb the excess runoff to the gut leading to Hovensa.

- North of Williams Delights ponds need to be developed to retain the excess storm water coming from Blue Mountain. This will reduce storm water runoff reaching the community of Williams Delight. In addition, small-diameter culverts need to be installed on the local roads of Williams Delight to reduce the localized flooding. The culverts can be connected to the major box culvert that was constructed a number of years ago at Williams Delight.

- Hannah's Rest where there is flooding of localized roads. A comprehensive drainage plan needs to be done for Hannah's Rest to address the many valleys in the roadways where water often seems to pond.

- Structural retrofit of the critical facilities used for sheltering should be considered such as Claude O. Markoe School and St. Croix Educational Complex.

- A generator is needed for the Red Cross Chapter Building for Saint Croix.

- Land erosion protection and vegetative cover plantings at the Red Cross Chapter Building for St. Croix.

- Retrofit existing and ensure new utility/infrastructure meet current earthquake standards for the USVI, such as pump stations, waste water treatment facilities, water treatment facilities, and power generation facilities.

- Provide additional drainage features along roadways with excessive sheet flow during rain events, roadside swales, and provide additional drainage inlets and culverts

- Provide seawall to protect Tsunami prone-infrastructure in main towns.
- Retrofit portions of Juan F. Luis Hospital roof for hurricane hazards.
- Clear drainage system in front of JFL Hospital to alleviate local flooding.

## 2.3 COORDINATION AMONG GOVERNMENT AGENCIES

For a State Hazard Mitigation Plan to become an effective tool in implementing hazard mitigation it cannot remain the sole province of VITEMA. Coordination among government agencies that have a role in implementing hazard mitigation is essential. For this plan update, coordination with government agencies was very similar to the process utilized during the 2011 Plan development. There were some changes in this process during this Plan Update; these include:

- Establishment of the Hazard Mitigation Steering Committee. This committee was formed for the specific intent of not only the Plan Update, but also its implementation. Unlike the Hazard Mitigation Monitoring and Evaluation Committee (HMMEC), established for each island, which included multi-agency participation, the HM Steering Committee included members only from VITEMA. It is necessary to note that initially the same government agencies were invited to participate in the steering committee, but it was decided that only VITEMA members would have a role in the steering committee. It also should be noted that FEMA played an advisory role in the Steering Committee meetings in that it emphasized the importance of addressing certain items in the Plan Update, particularly the importance of reviewing and integrating the HMA Unified Guidance, emphasizing the importance of updating severe repetitive loss strategy by integrating recommendations into the Territory's Mitigation Strategy and emphasizing the need to integrate climate change into the Hazard Identification and Risk Assessment, specifically sea level rise.

- Different Participants from Government Agencies. There was a marked reduction of Federal and Territory agencies that played a role in this Plan Update. During this Plan Update, many participants that were included on committees were familiar with the Hazard mitigation planning process. However, there were new members that required more information in order to arrive at a basic understanding of emergency management and hazard mitigation. As these persons gain a better understanding of FEMA programs, processes and terminology, the Plan Update process in the future will become more efficient.

- Identification of Key Stakeholders. Key stakeholders such as the Virgin Islands Territorial Emergency Management Agency (VITEMA), Department of Planning and Natural Resources (DPNR), and Department of Public Works (DPW) were identified during the planning process. These key agencies participated in the Hazard Mitigation Monitoring and Evaluation Committee Meetings and/or Public Informational Workshops. These agencies also made staff available for the Plan update, namely DPW and DPNR.

### 2.3.1 FACILITATING INTERAGENCY COORDINATION

There were numerous ways in which VITEMA encouraged coordination among US Virgin Island governmental departments, agencies and authorities. The most important way that VITEMA encouraged coordination was to invite representatives of the relevant agencies to participate in the Hazard Mitigation

Monitoring and Evaluation Committees. The list of Public Sector participation in the Committees, presented in Section 2.3.2, reflects the success that VITEMA had in involving a broad range of Territorial and Federal agencies in the mitigation planning process from the very beginning.

Public Sector participants were encouraged to discuss the planning process with other staff in their respective departments. This brought their collective insight and enabled identification of potential mitigation projects that could be brought back to subsequent Committee meetings. By interfacing with representatives of other VI departments within the setting of the Hazard Mitigation Committee meetings, participants gained an understanding of the respective roles of many agencies and departments. All of the agencies that participated in the Hazard Mitigation Committees meetings had a stake and a vote in identifying and prioritizing new hazard mitigation actions at the Territorial-level as well as for each major Island.

## 2.3.2 PARTICIPANTS

These workshops and meetings were facilitated by VITEMA and its consultants. A number of individuals from private and public sector played key roles in preparing the Plan Update. On a territory-wide basis, the three Committees reflected the participation from the following Federal and Territorial agencies, businesses, institutions, associations, and organizations:

### Public Sector

- Virgin Islands Territorial Emergency Management Agency (VITEMA)
- Department of Planning and Natural Resources (DPNR),
- VI Housing Authority
- VI Port Authority
- VI Property and Procurement
- VI Fire Service
- VI Police Department
- VI Department of Education
- Emergency Management Services (EMS)
- VI Department of Human Services
- VI Water and Power Authority

### Private Sector

- Tropical Shipping
- Caneel Bay Hotel
- Coral Bay Community Council
- Enfield Green Owner's Association

### Organizations

- University of the Virgin Islands
- The American Red Cross

## Federal Emergency Management Agency, Region II

FEMA Region II, through its Caribbean Area Division (CAD), San Juan, Puerto Rico participated in the Plan Update planning process. FEMA CAD's representative provided the territory training in Hazard Mitigation and the FEMA territory representative in the Virgin Islands, Mr. Leonard Gumbs, participated in an advisory capacity in the Hazard Mitigation Steering Committee, and in all public meetings.

## Consultants

The consultant for the Hazard Mitigation Plan Update was the Council for Information and Planning Alternatives, Inc. (CIPA). The consultant assisted in the following ways:

- Developing an appropriate planning process for the Plan Update;
- Providing technical support in performing the risk assessments for the Plan Update;
- Developing written materials for meetings and web postings;
- Facilitating VITEMA meetings and workshops and addressed Plan elements;
- Assembling information for inclusion in the Plan Update.

## 2.3.3 STAKEHOLDERS

VITEMA has undertaken a number of steps to encourage the widest range of stakeholder involvement from the onset of the Plan Update process. The Update of the US Virgin Islands Territorial Hazard Mitigation Plan was a collaborative effort resulting from dedicated efforts of a number US Virgin Islands agencies, departments, and authorities, in addition to the vital involvement of the public and private sectors.

1) Public notices were provided to the print and voice media, encouraging the general public and special interest groups to participate in the Plan Update process (Appendix B).

2) Representatives of government agencies were identified as key stakeholders and were invited to be members of the three Island Hazard Mitigation Monitoring and Evaluation Committees and/or participate in public workshops. The term "Stakeholders" as used in the rest of this Plan Update includes the following:

- Virgin Islands Territorial Emergency Management Agency (VITEMA)
- Department of Planning and Natural Resources (DPNR),
- Department of Public Works (DPW)
- VI Water and Power ((WAPA)
- VI Department of Education

## 2.3.3.1 Outreach to Virgin Island Agencies

In addition to involvement on the hazard mitigation committees, contacts were made with the important government agencies for the Plan Update in order to solicit their involvement in the review of key elements of the Plan. The meetings were held with the following agencies:

<u>The Department of Public Works (DPW)</u>

DPW has lead responsibility for the design, construction and maintenance of drainage infrastructure and public roads throughout the Islands;

The Department of Planning and Natural Resources (DPNR)
DPNR is responsible for administration of the Natural Flood Insurance Program (NFIP). It is also responsible for the following activities that have the potential to reduce the future vulnerability of the US Virgin Islands:

- Reviewing subdivision plans and development proposals
- Developing long-range land use plans and policies for the US Virgin Islands
- Approving building permits
- Conducting building inspections
- Protecting natural resources

VI Housing Authority
The Virgin Islands Housing Authority is empowered with the responsibility for planning, financing, constructing, maintaining and managing Public Housing Developments in the Territory, and in the future should play an important role in recovery efforts given the importance of the role given to the US Housing and Urban Development (HUD) under the new National Disaster Recovery Framework.

Meetings were held with each of the above referenced agencies to review existing plans, program and policies. Discussions focused around the development of appropriate hazard mitigation actions that should be included in this Plan Update.

Further to these discussions, a series of one-on-one interviews were held with mid-level representatives of key US Virgin Islands agencies. Their goal was twofold: to obtain legislation, regulations, plans, and policies relevant to hazard mitigation; and, to jointly discuss opportunities to encourage hazard mitigation in the agencies day-to-day, and strategic, long-term planning activities.

These meetings and discussions proved beneficial for improving coordination among these key agencies with a major role in implementing hazard mitigation.

## 2.3.3.2 Contributions from Interagency Coordination

First and foremost, the contributions to Plan's development from interagency coordination were reflected in the broad-based composition of the Hazard Mitigation Planning Committees. Representatives of Federal and Territorial agencies, departments and authorities actively participated in the Committee meetings. They provided oversight to VITEMA, contributed to the development of goals and objectives, and by voting to prioritize programmatic and island-specific mitigation actions. However, it is also important in the Plan Update to acknowledge the specific contributions made by key government agencies. They include:

- **Tax Assessor's Office**. The Tax Assessor's Office did not provide a copy of the Territory's tax database for this Plan Update. Instead, through its consultant, the CIPA consultant team was provided a summary of real property values so as to validate and calibrate its estimates. This data was used to develop damage estimates for specific natural hazards.

- **Department of Public Works.** DPW representatives participated as active members of the Hazard Mitigation Committees. In addition, the Department provided a list of projects that require Federal

funding to be constructed. Most of the projects listed were included in the Plan Update and address repetitive flooding problems. DPW representatives provided project descriptions for the Plan's mitigation actions.

- **Department of Planning and Natural Resources.** The Department contributed to the Plan development in many ways. They provided representatives to the numerous Committee meetings, in addition to facilitating numerous interviews between the VITEMA planning team and major DPNR divisions.

## 2.4 INTEGRATION WITH OTHER PLANNING EFFORTS

All relevant and completed plans and/or on-going planning efforts were reviewed for this Plan Update. The 2011 Plan provides a good departure point to identify new opportunities where hazard mitigation can be better integrated into US Virgin Islands long-range planning initiatives.

### 2.4.1 VIRGIN ISLANDS GOVERNMENT PROGRAMS

During the capability assessment for this Plan update, several DPNR planning initiatives are worth mentioning. They are USVI Zoning and Subdivision Code Update and several other NOAA watershed-based planning initiatives. The specific documents, highlighted below, were reviewed and specific comments about these plans related to hazard mitigation can be found in Section 4, Capability Assessment.

- *Coral Bay Watershed Management Plan: A Pilot Project for Watershed Planning in the USVI,* Center for Watershed Protection, (2008)
- *St. Croix East End Marine Park Management Plan*, VI Nature Conservancy and UVI for DPNR, Division of Coastal Zone Management (2002)
- *St. Croix East End Marine Watersheds Management Plan, USVI DPNR, NOAA, USDA NRCS (2011)*
- *USVI Zoning and Subdivision Code Revisions,* currently under development by Rutgers University and Duncan Associates, in conjunction with the Community Foundation of the Virgin Islands

The *USVI Zoning and Subdivision Code Update,* currently under development, should be ready for public and legislative review and comment in mid-2014, and is intended to create a more streamlined, enforceable zoning process. This revision will consider and identify areas where DPNR can expand its managerial, administrative, technical and human capacity and will have a positive impact on mitigating adverse impacts of residential and commercial development in hazard prone areas.

### 2.4.2 FEMA MITIGATION PROGRAMS

There are been significant changes to FEMA's national disaster management organizational structure and a consolidation of a number of hazard mitigation grant programs that have occurred since the last USVI Plan Update in April of 2011.

Soon after the last Plan Update was completed, FEMA rolled out the National Disaster Recovery Framework (NRDF) which realigned the roles of a number of Federal agencies regarding disaster recovery.

Six groupings of core recovery capabilities, called Recovery Support Functions (RSFs) were delineated and primary and secondary Federal agencies associated with each RSF. The six RSFs are:

- *Community Planning and Capacity Building*
- *Infrastructure System*
- *Housing*
- *Economic Development*
- *Natural and Cultural Resources*
- Health and Social Services

Although FEMA retains the central planning and coordination role in post-disaster situations, several Federal agencies will have a more defined role in recovery, particularly for the housing and economic development RSFs. VITEMA will establish relationships in the steady-state (pre-disaster) timeframe with US Housing and Urban Development (HUD) and US Department of Commerce (DOC) representatives that could facilitate recovery in the future post-disaster conditions.

The most obvious programs and initiatives for VITEMA to integrate with are FEMA mitigation grant programs. VITEMA serves as the lead agency for the Territory in FEMA related grant administration and will be the “Applicant” in most, if not all, of FEMA hazard mitigation grant applications. VITEMA is responsible for soliciting sub-applications from eligible sub-applicants; assist them in preparing them and submitting eligible, complete applications to FEMA in a prioritized order. Upon award, VITEMA becomes the “Grantee”, monitoring and managing grant administration on behalf of the “Sub-Grantees”.

FEMA has consolidated its hazard mitigation grant programs under the Hazard Mitigation Assistance (HMA) Unified Guidance, first issued in July of 2013. The Territory should take advantage of HMA funding programs in both the pre- and post-disaster timelines. The three consolidated hazard mitigation programs include:

- Hazard Mitigation Grant program
- Pre-Disaster Mitigation Grant program
- Flood Mitigation Assistance Program

The National Mitigation Framework, finalized in May 2013, describes the following seven core capabilities:

- Threats and hazard identification;
- Risk and disaster resilience assessment;
- Planning;
- Community resilience
- Public information and warning;
- Long-term vulnerability reduction; and,
- Operational coordination.

HMA programs reduce community vulnerability to disasters, promoting individual and community resilience, and enabling a more efficient and more rapid recovery following natural disasters. For both the Territory and the Nation, taking advantage of HMA programs will reduce response and recovery resource requirements. From the perspective of the National Mitigation Framework, the HMA programs will lead to safer, more sustainable communities that are less reliant on external financial assistance.

A more detailed description of key changes to FEMA mitigation programs since the last Plan Update is provided in Section 3 – Capability Assessment, in addition to Appendix H which lists all hazard mitigation program changes that are reflected in the July 2013 HMA Unified Guidance.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims and Severe Repetitive Loss grant programs. Cost share requirements have been changed to allow more Federal funds for properties with repetitive flood claims and severe loss properties.

This Plan Update includes a repetitive loss strategy that is consistent with the 2004 amendments to the National Flood Insurance Act (42 U.S.C 4001 et seq). The National Flood Insurance Act was amended to "introduce a mitigation plan requirement as a condition of receiving a reduced local cost share for the activities that mitigate severe repetitive loss properties under the Flood Mitigation Assistance and Severe Repetitive Loss grant programs". The October 31, 2007, interim final rule established this requirement under the 44 CFR § 201.4 (c)(3)(v) to allow a state to request the reduced costs share under the FMA and SRL programs if it has an approved State Mitigation Plan that also includes an approved Severe Repetitive Loss Strategy" (FEMA, Multi-Hazard Planning Guidance, 2008).

The most recent guidance (HMA Unified Guidance 2013) on crafting an effective repetitive loss strategy is that States and Territories need to describe specific actions that the Territory has taken to reduce the number of repetitive loss properties and clearly outline the steps planned to reduce the number of repetitive properties over time.

This Plan Update incorporates the goals and objectives of the repetitive loss strategy in Section 5 Mitigation Strategy and then provides additional detail on how the Territory plans to achieve those reductions is outlined in Appendix C. The Territory's approach is primarily focused on public education, data collection, and direct mitigation actions focused on minimizing repetitive losses. The actions are reflected in both the discussion on programmatic and island specific hazard mitigation actions.

This section includes the following five subsections:

- 3.1 The IFR Requirements for Capability Assessments
- 3.2 US Virgin Islands Policies, Programs and Capabilities
- 3.3 Funding
- 3.4 Analysis and Evaluation of US Virgin Islands Departments, Agencies and Authorities
- 3.5 Summary and Recommendations

## 3.1 THE IFR REQUIREMENT FOR CAPABILITY ASSESSMENTS

The Interim Final Rule (IFR) includes two specific requirements for conducting capability assessments as part of Standard State Hazard Mitigation Plans:

- **State Capability Assessment** per **Requirement §201.4(c)(3)(ii): "[***The State mitigation strategy shall include a] discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas [and] a discussion of State funding capabilities for hazard mitigation projects*"
- **Local Capability Assessment** per **Requirement §201.4(c)(3)(ii): "[**T*he State mitigation strategy shall include] a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities…"*

The Disaster Mitigation Act of 2000 (DMA 2000) requires that the territories of the United States, including the US Virgin Islands, meet the IFR requirements for States. However, the US Virgin Islands differs from the 50 States in one important way. Although the islands of St. Croix, St. John and St. Thomas could be considered as distinct "communities" in many regards, there are no incorporated units of local government. Since there are no incorporated counties, municipalities or subunits below the Territorial government that can promulgate or enforce "local" policies, programs or regulations, the requirement for a "Local Capability Assessment" does not apply and is not addressed in this Plan.

# 3.2 US VIRGIN ISLANDS POLICIES, PROGRAMS AND CAPABILITIES

An important purpose of this assessment is to identify the capabilities that need to be strengthened to assure successful implementation of programs, and the rules and regulations intended to support the hazard mitigation related policies of the US Virgin Islands.

The remaining portions of this subsection of the Plan address:

- Policies
- Programs, Rules and Regulations

## 3.2.1 KEY WORD DEFINITIONS

The IFR does not provide definitions for key words in its requirements, i.e., "*policies, programs and capabilities*". For the purposes of this assessment, the following definitions will be used:

- *Policies* – are statements included in the Territory's plans or enabling legislation that express the vision or intent of the US Virgin Islands government. In the specific context of this plan, policies are identified that already do, or feasibly can, support hazard mitigation in the US Virgin Islands.
- *Programs* – are related, coordinated activities by one or more agency that have a distinct focus or purpose. Often, programs are developed as a direct response to policies and are enabled by the corresponding legislation or executive order. In the context of this assessment, relevant programs are often directly linked to rules and regulations.
- *Capabilities* – as used in this document, describe the past performance and future potential of agencies to carry out programs. As a simple example, if you want to build a house (the "program"), you need to assess your capability to do so. You should look at the materials and tools you have or need to buy; the skills you have or can hire (carpenters, electricians, plumbers, etc.); and whether the money you have saved for the project will be enough.
- Under this definition and for this particular planning exercise, capabilities refer to the strength and weaknesses of rules and regulations ("tools and materials"), the adequacy of human resources to carry out administrative procedures and enforcement activities (the "skills" to implement the program) and the funds available to maintain operations and provide capital improvements (the "project budget").

## 3.2.2 CAPABILITY ASSESSMENT INTERVIEWS

For the Plan Update, the majority of capability assessment interviews involved representatives from VITEMA, DPNR, DPW and VI Housing Authority. The following list identifies the name, title and affiliation of US Virgin Islands officials interviewed during the capability assessment:

**Department of Planning and Natural Resources:**

- T. Stuart Smith, DPNR, Director of Planning
- Phillip Smith, DPNR STT, Director, Director of Permits

**Virgin Islands Territory Emergency Management Agency**

- Austin Callwood, Deputy Director
- Haldor Farquhar, Mitigation Chief,
- Joanne White, Grants Specialist

**Virgin Islands Housing Authority**

- Robert Graham, Executive Director,
- Lydia Hughes, Director of Modernization & Development
- Mrs. Monique Farrell, Construction Manager

**Department of Public Works:**

- Nicole Turner, P.E., , DPW STT, District Engineer

**Other Agency Representatives Interviewed:**

- Leonard Gumbs, Structural Engineer, FEMA CAO

### 3.2.3 POLICIES

This section provides a summary of plans, policies and legislation that lay out specific goals, objectives and policy statements that already do, or potentially could, support pre- and post-disaster hazard mitigation. The plans reviewed for the Plan Update include land use and environmental planning documents, specific hazard mitigation plans, and other emergency management plans. They are listed below:

## Land Use and Environmental Planning Documents

- *Coastal Land and Water Use Plan* (see "Coastal Zone Management" under Section 2.3.1)
- *St. Croix East End Marine Park Management Plan*, VI Nature Conservancy and UVI for DPNR, Division of Coastal Zone Management (2002)
- *Coral Bay Watershed Management Plan: A Pilot Project for Watershed Planning in the USVI,* Center for Watershed Protection, (2008)
- *St. Croix East End Marine Watersheds Management Plan, USVI DPNR, NOAA, USDA NRCS (2011)*
- *USVI Zoning and Subdivision Code Update,* currently under development by Rutgers University and Duncan Associates, in conjunction with the Community Foundation of the Virgin Islands

Activities related to other areas or phases of emergency management were not evaluated for this Plan Update.

## All Hazard or Hazard Specific Mitigation Plans

- Natural Hazard Mitigation Plan for the US Virgin Islands, David Brower, Esq. and Timothy Beatley, Ph.D., for VITEMA (1988)
- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for VITEMA (1995)
- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for OMB (1999)
- Virgin Islands Flood Hazard Mitigation Plan, Island Resources Foundation for VITEMA, funded by FEMA FMA grant (2000)
- Phase 4 Report, Earthquake Hazards Reduction Plan, Geoscience Associates, for VITEMA, funded by FEMA grant EMA-K-86-0055 (1987)

## Emergency Management Plans

- US Virgin Islands Territorial Recovery Operations, Part II, Territorial Disaster Recovery Assistance Handbook on Federal Programs, VITEMA (1992)
- Disaster Management Guide for the US Virgin Islands. FEMA Region II CAO (2004)
- Hurricane Evacuation Study for the US Virgin Islands, Technical Summary, US Army Corps of Engineers for VITEMA (1994)
- WAPA Emergency Operations Plan, WAPA (2003)

These plans provide a solid base for the maintenance, development and pursuit of coordinated programs that can reduce the risk of damage and loss from natural disasters in the US Virgin Islands.

## Comprehensive Planning

As highlighted in the 2005, 2008 and 2011 Plans, the *Comprehensive Land and Water Use Plan (CLWUP)* adhered to goals and objectives laid out in the "*Guidelines for the Development of a Long-Range Comprehensive Plan for the United States Virgin Islands*" adopted by Executive Order No. 333-1991 on May 17, 1991.

The *Comprehensive Land and Water Use Plan* (CLWUP) proposed to incorporate territorial-wide land and water use guidelines developed by the V.I. Department of Planning and Natural Resources (DPNR) into the Virgin Islands Code (V.I. Code). In 2005, a formal bill was proposed by V.I. Senator Richards (Bill No. 25-0209) which sought to amend title 29, chapter 3, Virgin Islands Code, to enact the "Virgin Islands Development Law of 2003". Bill No 25-0209, which sought to provide for a comprehensive land and water use plan for the U.S. Virgin Islands and also called for the revision of zoning districts on all islands of the US Virgin Islands.

The CLWUP was perceived by the Legislature and stakeholders as too restrictive to the economic development of the US Virgin Islands and the draft bill was held in abeyance in legislative committee. There are currently no long-range comprehensive or master plans in process for the US Virgin Islands. However, DPNR is in the process of developing zoning and subdivision code revisions, which will be in compliance with all existing legislation, and will hopefully provide a basis for the eventual development and adoption of a comprehensive land-use plan, as required by Territorial law.

The zoning and subdivision code revisions are being developed with the assistance of Rutgers University. This project includes the following components:

- Comprehensive update and modernization of existing zoning and subdivision codes
- Organization, layout, ease-of-use/administration
- Internal/external consistency
- Administration/procedural clarity & efficiency
- Strategic amendments to address identified issues and opportunities
- Introduction of form-based floating zone
- Urban design plan for areas in Charlotte Amalie

These revisions are anticipated to support the process of moving towards the development of long-range comprehensive plan. A number of sections of the draft zoning and subdivision sections have been presented to a review committee and interested stakeholders. As of May 8, 2014, DPNR anticipates that the revisions will be finalized over the next several months, at which time they will be presented to both the Territorial Legislature and the public.

These code revisions will address significant, current issues related to hazard mitigation, including erosion control and management of storm water runoff. The major elements of the code revision are anticipated to encompass both technical standards and performance standards. It is anticipated that the code revisions will be complete and adopted in time for future Plan Updates, and that more information regarding the specifics of the code revisions will be available at that time.

Other plans include policy-related statements that are more focused on specific hazard mitigation issues. Although outdated by the consolidation of hazard mitigation programs in the HMA Unified Guidance, the *US Virgin Islands Flood Mitigation Plan*, adopted in 2003, is still relevant today. The goals and objectives highlighted in the 2003 plan were reflected in this Plan Update and clearly support both pre- and post-disaster hazard mitigation activities for flooding, one of the key hazards for the US Virgin Islands.

As such, the foundations of these plans continue to provide a solid base for the maintenance, development and pursuit of coordinated programs that can reduce the risk of damage and loss from natural disasters in the US Virgin Islands. The extent to which the Territory has been successful in building on this base is discussed in the following subsections. After the descriptions of these programs, Section 3.5– Summary and Recommendations relates each plan's "policies", as well as the related programs, rules and regulations to the elements of the IFR requirements.

## 3.2.4 Programs, Rules and Regulations

This subsection describes relevant programs, rules and regulations of the US Virgin Islands. The discussion is organized by four main headings:

- Pre-disaster hazard mitigation;
- Post-disaster hazard mitigation;
- Other related programs; and
- Proposed programs.

### 3.2.4.1 Pre-Disaster Hazard Mitigation

Programs, rules and regulations that are focused primarily or substantially on pre-disaster hazard mitigation in the US Virgin Islands include:

- Floodplain Management;
- Coastal Zone Management; and
- Land Development Regulations (e.g., zoning; subdivision regulations; building codes).

#### 3.2.4.1.1 Floodplain Management

Current pre-disaster floodplain management efforts in the US Virgin Islands are pursued through four interrelated programs:

- National Floodplain Insurance Program;
- US Virgin Islands Flood Map Modernization Program;
- US Virgin Islands Flood Hazard Mitigation Plan; and
- Flood Damage Prevention Rules.

***National Floodplain Insurance Program***

Through the National Floodplain Insurance Program (NFIP), FEMA provides Federal insurance for structures and their contents located in participating communities. The NFIP was enacted by the Federal government in 1968 to help reduce flood damage by regulating new development in flood prone areas and to provide flood insurance to the general public at reasonable rates to cover damages to buildings and their contents caused by flooding.

In order to participate and qualify their residents for flood insurance, communities must adopt minimum regulations governing floodplain development. For example, participating communities must prohibit new development in designated floodways that raises flood levels. In addition, the lowest floor of all new buildings in Special Flood Hazard Areas must be elevated to or above the height of the base flood elevation or "100-year flood". A third significant requirement is that subdivisions must be designed to minimize exposure to flood hazards. Added standards are imposed on communities where the flood hazard is compounded by coastal wave action or "V" zones as described in Section 4.2 – Hazard Identification and Profiles.

In June 2004, the National Flood Insurance Act (42 U.S.C. 4001 et seq.) was amended to introduce a mitigation plan requirement as a condition of receiving a reduced local cost share for activities that mitigate severe repetitive loss properties under the Flood Mitigation Assistance (FMA) and Severe Repetitive Loss (SRL) grant programs. The October 2007, Interim Final Rule established this requirement under 44 CFR §201.4(c) 93) (v) to allow a State to request the reduced cost share under the FMA and SRL programs if it has an approved State Mitigation Plan that also included an approved Severe Repetitive Loss Strategy (contained in Appendix C).

The US Virgin Islands has been a member of the NFIP since 1980. The Territory adopted NFIP-compliant floodplain management provisions in 1993. See discussion under "Flood Damage Prevention Rules" below for a description and evaluation of the rules and regulations enacted by the US Virgin Islands that help satisfy the statutory requirements associated with their NFIP participation. The program is administered by DPNR, Division of Permits. The Director of Permits is the designated NFIP Coordinator for the US Virgin Islands.

**Evaluation / Assessment**

The NFIP was an important impetus for the enactment of the US Virgin Islands Flood Damage Prevention Rules. In addition, the program has provided loss coverage for a significant number of properties. It is important to note that of the 2,061 policies that are currently in force (2/28/2014 policy data FEMA R2), approximately 225 cover "repetitive loss properties", properties that are currently insured for which two or more NFIP losses (occurring more than ten days apart) of at least $1,000 damage each have been paid within any 10-year period since 1978 (FMA, 2000). As of November 2010, following Hurricane Earl (FEMA Disaster Declaration DR-1939-VI), there were 250 repetitive loss properties in the NFIP database. Removing duplicate and other entry errors, along with three structures removed from the list through implementation of a FMA-funded hazard mitigation project (Note: these are the most current years for which NFIP and SRL data that was made available to VITEMA.)

The prioritization of mitigation activities to reduce the number of repetitive loss properties (through acquisition, elevation, etc.) is consistent with actions outlined in Section 5 of this Plan.

Also, in evaluating the impact of the current floodplain management program in the US Virgin Islands, three other issues are important to examine:

- NFIP policy coverage assessment – Using October 2007 data from the Flood Hazard Mitigation Plan, there were 2,535 policies with insurance coverage totaling $350,594,700 in the US Virgin Islands. This represents an addition of approximately 535 policies since the 2000 FMA Plan. The 2000 FMA Plan also reported that the results of reviewing aerial photographs of the islands indicated that as much as 10 percent of the Territorial housing units are located in the Special Flood Hazard Area. Given that there are at least 50,500 housing units in the islands, 10 percent would yield approximately 5,050 units within the SFHA. If that is the case, NFIP policies cover approximately one half of the total eligible properties. When you realize that this calculation does not include commercial properties and that a higher proportion of them are probably located in or near the SFHA, then the resulting coverage rate is most likely even less.
- Insurance claims -- Data compiled for the 2004 Map Modernization Business Plan indicate that, as of March 2004, there were over 2,400 policies in force and over 2,500 insurance claims in the US Virgin Islands, resulting in an average 1.05 claims per policy. As of October 2007, there were over 2,535 policies in force and over 2,783 insurance claims filed in the Territory, resulting in an average 1.11 claims per policy.
- Repetitive Loss Insurance claims – Since the inception of the Virgin Islands qualification for NFIP in 1980 through November 2010, two-hundred and twenty five (225) properties have been identified and validated as repetitive flood loss properties. The total number of properties identified and validated as severe repetitive losses is three (3), making it a very small subset of the whole. The distribution of these properties is as follows:
    - St. Croix: 133 Repetitive Loss; 3 Severe Repetitive Loss
    - St. John: 2 Repetitive Loss
    - St. Thomas: 112 Repetitive Loss

  The figures above represent two hundred and fifty (250) total properties initially identified as repetitive loss or severe repetitive loss. Of these two hundred and fifty (250) identified properties, two hundred and twenty five (225) were later validated by FEMA. The twenty-five (25) that were removed from the list consisted primarily of duplicate entries, with others being mitigated properties or vacant lots.

  These repetitive loss and severe repetitive loss properties have filed six hundred and seventy (670) claims in the previous thirty (30) years, and have received payments of $33,417,083.88. This produces an average claim of $49,876.24 per property, or an average of $1,662.54 per property each year for the previous thirty (30) years.

The relationship of the number of policies versus claims is overly simplistic, and likely does not accurately depict the flood risk to properties in the Territory. Nevertheless, the increasing number of claims is disconcerting and may indicate the need for more careful development review and long-range comprehensive planning. The Territory has a substantial opportunity to address and take positive action relative to reducing the number of Repetitive Flood Loss properties. This Plan Update outlines specific actions (See Appendix G) to target these properties and the surrounding environ that perpetuates these losses.

Simple measures in the development review process have potential to pay dividends in reducing future flood-related disaster damages. Care should also be taken to make sure that well intentioned programs like the NFIP are focused on providing coverage for properties that are already at risk, not to support the development of new sources of risk and loss for the community.

### *Flood Insurance Rate Maps (FIRMs)*

The NFIP issues Flood Insurance Rate Maps (FIRMs), which delineate the Special Flood Hazard Areas (SFHA) as either A-zones (riverine flooding) or V-zones (coastal flood hazard areas). The FIRMs, which have been utilized in the Virgin Islands since their initial issuance in August 1980, have served a useful purpose for establishing insurance rates.

The 2000 Flood Hazard Mitigation Plan provided a detailed analysis that documents extensive coastal and riverine flood damages outside of the regulatory SFHA boundaries. These maps have been updated and reissued in April 2007 and provide the Territory with a more useful resource for planning and site specific decision making.

The 2007 *US Virgin Islands Digital Flood Insurance Rate Maps (DFIRMs)* are consistent with the proposed five-year strategy for modernizing FEMA FIRMs and Flood Insurance Studies (FISs) in the Territory. The March 2004 strategy stated: "*Because of the steep terrain on all three islands, there is also a need to update riverine studies in US Virgin Islands. Many of the riverine flood hazards are currently shown on the FIRM as approximate floodplains, which do not provide enough detail to properly mitigate risk and provide sound floodplain management. To better manage development in these areas, US Virgin Islands requests that all the riverine flood hazards be studied in detail*".

<u>Evaluation / Assessment</u>

Metadata accompanying the USVI DFIRM database indicates that: *"The published effective FIRM and DFIRM maps are issued as the official designation of the SFHAs. As such they are adopted by local communities and form the basis for administration of the NFIP. For these purposes they are authoritative..."* (FEMA MSC, 2007). The data for the development of these maps is consistent with the "Guidelines and Specifications for Flood Hazard Mapping Partners" (FEMA, 2003). The DFIRMS are used as reference and to obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the FIS report (FEMA,2007).

The DFIRM data has been provided to the US Virgin Islands in both hardcopy and as a GIS-enabled product, which is consistent with FEMA's goals of distributing DFIRMs as GIS data online for the population of US Virgin Islands.

### *Flood Hazard Mitigation Plan*

In July 2000, the US Virgin Islands Territorial Emergency Management Agency (VITEMA) completed the *US Virgin Islands Flood Hazard Mitigation Plan,* which was subsequently adopted in

2003. This plan was developed to preserve the eligibility of the US Virgin Islands for project grants from FEMA's Flood Mitigation Assistance (FMA) Program.

The plan is based on goals and objectives that were detailed earlier in Section 3.2. The plan also outlines an extensive series of recommended mitigation measures, some of which have been implemented. These include:

- Traditional property protection (e.g., elevation of flood prone structures, flood proofing, etc.);
- structural mitigation measures (e.g., retention basins, levees or flood walls, etc.) for specific areas of concern; and
- Recommendations to improve emergency response and recovery actions (see more detailed discussion of this part of the plan under Section 2.3.2 – Post-Disaster Hazard Mitigation).

The *US Virgin Islands Flood Hazard Mitigation Plan* also recommended the updating US Virgin Islands FIRMs. This action has finally been implemented and the results are highlighted in the subsection above.

Evaluation / Assessment

The *US Virgin Islands Flood Hazard Mitigation Plan* (2000) plan has not been updated; in fact, there is no need to update this Plan, given FEMA's Unified Guidance for the Hazard Mitigation Assistance programs, final version dated February 14, 2014. By bringing all of the major hazard mitigation grant programs (HMGP, PDM, and FMA) under one combined and simplified grant process, there is no need for a separate Flood Hazard Mitigation Plan. In essence, this update of USVI Territorial Hazard Mitigation Plan, and all future updates, integrates flood hazard mitigation as one important component of an all-hazard perspective. The 2000 FMA plan included recommendations in two important areas.

- Regulation and Permitting - recognizing that existing rules and regulations governing flood hazard mitigation are of little value without adequate enforcement, the plan identified six different recommendations under this heading including:

  1. Adequately staff, train and equip regulatory agencies charged with issuing permits;
  2. Provide training and education for government officials, developers and residents;
  3. Add flood hazard mitigation criteria to Coastal Zone Management (CZM) permitting (see discussion below regarding the CZM Program);
  4. Designate the SFHAs as an Area of Particular Concern (see CZM);
  5. Strengthen implementation and enforcement aspects of zoning and subdivision regulations (see discussion below under Land Development Regulations); and
  6. Ensure strict enforcement of the US Virgin Islands Building Code (see Land Development Regulations).

- Watershed Management Approach – recognizing that "*the success of the Flood Hazard Mitigation Plan relies on its implementation*" and building on an established principal

strategy for controlling pollutant discharges in the US Virgin Islands under the §6217 Coastal Non-Point Pollution Control Program (see discussion below under Section 2.3.3 – Other Related Programs), the plan highlighted the benefits of implementation based on hydrologic units (watersheds or drainage basins). This approach would also be consistent with related efforts under the Unified Watershed Assessment and Restoration Priorities Program (see Section 2.3.3) and could increase the effectiveness and efficiency of all three programs.

The recommendations highlighted above are reflected in the programmatic actions of this Plan Update (see Section 5.3.2). Specific flood mitigation actions such as structural mitigation measures (e.g., retention basins, levees or flood walls, etc.) for specific areas of concerns are highlighted in Sections 5.3.3; 5.3.4 and 5.3.5. Also addressed are several proposed actions to develop hydrological and hydraulic analyses and watershed-based studies to address repetitive losses.

### *Flood Damage Prevention*

The Territory adopted NFIP-compliant floodplain management provisions under Rules and Regulations on Flood Damage Prevention, Title 3. Executive Chapter 22, Department of Planning and Natural Resources, Subchapter 401(b)(15), VIRR on July 8, 1993. The Rules and Regulations apply only to the areas defined on the most recent FIRMs as the Special Flood Hazard Areas (SFHA). In these areas, a permit is required for any type of development procedure or change to the floodplain including excavation, dredging, filling, drilling, modification to existing structures and construction of new structures. The Rules and Regulations reference the appropriate provisions of Section 44 of the Code of Federal Regulations (44 CFR) as General Standards, but add a number of general and specific standards.

The Commissioner of DPNR is appointed to administer and implement the provisions of these regulations, and may request the assistance of other departments and agencies to provide technical assistance. Administration of the rules and regulations includes a number of responsibilities, which can be grouped according to the following categories:

- Permit application and plan reviews – to determine whether development can occur in proposed locations and if so, if the proposed development complies with the regulations and any established criteria,
- Field verifications and determinations – for flood elevations and to resolve ambiguities or disagreements regarding the locations of flood zone boundaries or determination of BFEs, and
- Monitoring compliance with approved permits and plans.

<u>Evaluation / Assessment</u>

Aspects of these standards that should be considered for revision or refinement in the context of this Plan are as follows:

- The basis for determining whether or not the Rules and Regulations are applicable to any particular permit application is based on information in the FIRMs, i.e., "*is the proposed activity in or out of the SFHA?*" It has been noted above that the FIRMs have been updated. The intention of the update is to provide the Territory with "more useful resource for planning and site specific decision making";
- Residential and non-residential construction in the SFHA must be built so that the lowest floor (including basement) is set at the base flood elevation [401(b)(15)(b)(1-2)]. Requiring additional freeboard (as little as one (1) foot above the base flood elevation) would significantly reduce the potential for damages from common storms without significantly increasing construction costs.
- In Coastal High Hazard SFHAs (i.e., V-zones), buildings must be constructed such that the lowest supporting horizontal members are located at the BFE [401(b)(15)(b)(5)(B)]. As noted in the preceding item, reductions in losses can be realized by increasing the "freeboard" requirements of this part of the Rules and Regulations.
- Demonstrations that flood elevations will not be increased by fill within the SFHA or encroachments on streams or guts without established base flood elevations or floodways are required but no specific procedures or evaluation criteria for these determinations are provided [401(b)(15)(c)].
- Subdivision provisions contain vague language such as "minimize flood damage" and "reduce exposure to flood hazards," but do not require (or even suggest) actual avoidance of construction in these areas other than excluding the floodway from subdivisions. The regulations could require avoidance with a provision where developers can attempt to demonstrate (with appropriate procedures and evaluation criteria) that avoidance is not reasonable or feasible. This would put the "burden" on the developers, not on the DPNR reviewers. Revisions to the subdivision regulations, currently in process, should help to clarify requirements to address storm water runoff and amounts of impervious coverage allowed.
- Subdivision provisions do not require that each lot include an area outside of the SFHA with adequate area to site buildings per zoning designation. As in the previous item, this could be a requirement with a provision for developers to demonstrate (with appropriate procedures and evaluation criteria) that such provisions are not reasonable or feasible.

In addition, relative to the Territorial Hazard Mitigation Plan, one of the key responsibilities of DPNR is to review and evaluate development permit applications, including making a determination as to whether or not development will take place in a flood prone area. Procedures for preparing permit applications for development in the floodplain are well defined in the regulations. In fact, most of the document is concerned with how to make development that is "destined" to occur in the flood hazard areas as flood proof or resistant as possible. Unfortunately, for the most part, the Flood Damage Prevention Rules and Regulations do not provide a strong basis for excluding development from high risk areas within the floodplain altogether.

### 3.2.4.1.2 Coastal Zone Management

The Federal Coastal Zone Management Act of 1972 included requirements for the States and Territories of the United States to develop a coastal zone management program. The US Virgin Islands Coastal Zone Management Act of 1978 became effective in 1979. The resulting US Virgin Islands Coastal Zone Management Program was prepared by the US Virgin Islands Planning Office (which has since been reorganized as DPNR) and submitted by the Governor to the US Department of Commerce.

The Program, as articulated in Title 12 VIRR, Chapter 21, §901-14, is based on a fundamental desire to preserve a significant environmental resource that benefits the economy and quality of life for the Territory's residents. Included with the Program's "findings and goals" (§903) are statements that directly relate to hazard mitigation including:

- "*there has been uncontrolled and uncoordinated development of the shorelines…*" [Title 12 VIRR, Chapter 21, §903 (a)(6)]; and
- "*improper development of the coastal zone and its resources has resulted in … erosion, sediment deposition, increased flooding, gut and drainage fillings…*" [Title 12 VIRR, Chapter 21, §903 (a)(6)]

In addition, §906 identifies a wide range of policies "applicable to the first tier of the coastal zone" that specifically reference hazard mitigation issues including development policy:

- "*to the extent feasible, discourage further growth and development in flood-prone areas and assure that development in these areas is so designed as to minimize risks to life and property*;" [Title 12 VIRR, Chapter 21 §906 (a)(9)],

and environmental policy:

- "*to … assure that activities in or adjacent to [complexes of marine resource systems … including reefs, marine meadows, salt ponds, mangroves and other natural systems] are designed and carried out so as to minimize adverse effects on … storm buffering capabilities*," [Title 12 VIRR, Chapter 21, §906 (b)(2)].

DPNR is the central territorial agency for administration of the Coastal Zone Management program in the US Virgin Islands. Other principal entities include the Office of the Governor, Legislature, the Department of Public Works and the Board of Land Use Appeals. The Coastal Zone Management Act created a Coastal Zone Management Commission within DPNR. A Division of Coastal Zone Management was also created within DPNR to assist the Commission and the Commissioner in administration and enforcement of the Act. There are three committees within the Commission, one for each major island. Each committee has authority over the administration of the Program within its "jurisdiction" including:

- issuance of Coastal Zone Management (CZM) permits;
- compliance with requirements related to Areas of Particular Concern (APC); and
- compliance with requirements related to the Coastal Barrier Resources Act (CBRA).

***Coastal Zone Management Permits***

The Coastal Land and Water Use Plan was approved and implemented as part of Title 12 VIRR, Chapter 21, §910. The Plan provides comprehensive guidelines for development of Tier 1 of the Coastal Zone.

Tier 1 is defined as the area extending from the outer limit of the territorial sea (including offshore islands) to distances inland as indicated on a set of maps. The Tier 1 area does not necessarily correspond to consistent physiographic characteristics or other regulatory boundaries such as the SFHAs, DPNR regulatory buffers (to wetlands, guts, and salt ponds).Tier 2 includes all other interior portions of the three major islands.

CZM permits are only required for development proposed in Tier 1. The appropriate committee of the Coastal Zone Management Commission or the Commissioner must find that "*the development as finally proposed incorporates to the maximum extent feasible mitigation measures to substantially lessen or eliminate any and all adverse environmental impacts of the development; otherwise the permit application shall be denied*." [Title 12 VIRR, Chapter 21, §910 (a)(2)]. It is also worth noting an important exclusion from the requirements for a CZM permit for existing structures as "*no coastal zone permit shall be required pursuant to this chapter for activities related to the repair or maintenance of an object or facility located in the coastal zone, where such activities shall not result in an addition to, or enlargement, or expansion of such object or facility.*" [Title 12 VIRR, Chapter 21§903 (b)(1)]

In addition, the Coastal Zone Management Act made provisions for two different levels of permits; major and minor, which are administered with slight differences for land and water based projects. Major permits incorporate the requirements of the zoning use permit; the earth change permit, shoreline alteration and submerged lands permit (see discussion of Land Development Requirements below). In addition, Environmental Assessment Reports (EARs) are required for major and minor water projects and for all major land projects in Tier 1. The EARs include requirements for submittal of information regarding:

- Climate and weather conditions including potential impacts resulting from wind, wave and flooding;
- Landforms, geology and soils;
- Drainage, flooding and erosion control;
- Oceanography;
- Marine resources;
- Terrestrial resources;
- Wetlands;
- Rare and endangered species; and
- Air quality.

As detailed in Title 12 VIRR, Chapter 21, §910 (c), major permits are required for all development except:

- "*a development which is to be conducted completely or substantially seaward of the line of mean high tide*" but meeting definitions of permissible activities established by the appropriate committee of the Commission (e.g., navigation buoys, moorings for vessels, etc.);
- construction of one or two single-family residences;

- construction of a duplex;
- improvements to an existing structure below an established cost threshold (currently set at $94,000);
- the development of one or more structures valued in their entirety below a threshold (currently set at $136,000);
- any other development, except the extraction of minerals, valued below a threshold ($120,000); and
- the extraction of minerals valued below the current threshold ($31,000).

In addition, a major permit is not required for subdivisions. For all these activities excluded from the major permit, a minor permit is required but the requirements for submittal and approval are correspondingly weaker. In particular, as noted above, EAR's are not required for minor permits. However, there is a provision in Title 12 VIRR, Chapter 21, §910 (c)(2)(E), that "*if the Commissioner, upon reviewing any minor permit application …, determines that the proposed activity is likely to have significant adverse environmental consequences he shall, upon giving notice to the applicant, forward such application to the appropriate Committee of the Commission for review as a major coastal zone permit*."

Evaluation / Assessment

The CZM permit can be an important part of the process of protecting coastal resources and reducing the impacts of natural hazards on people and property. However, there are inherent weaknesses in the systems that need to be addressed to provide consistent and meaningful hazard mitigation results in the Territory, including:

- The Virgin Island Coastal Zone Management program faces increasing pressure to make decisions regarding competing demands for tourist development, protection of existing threatened properties and the rights of private property owners. The relative small size of the islands, the essential connection between the coastal resources and the watersheds that lie above them and the magnitude of the natural hazards that the islands are subjected to, all make a strong argument that the Coastal Zone and Coastal Zone permits should be extended. At a minimum, all development throughout the Territory should be reviewed at the same level of scrutiny as those permit applications in Tier 1. If the CZM permit system were consistently and aggressively administered, it could provide the appropriate information regarding potential impacts of proposed development on the built and natural elements of the islands and in turn, the impacts of natural hazards on the proposed development.
- In addition, excluding subdivision from review as a major permit activity (in essence, bypassing the requirements for EARs) substantially weakens the system. By not requiring an environmental assessment and an accounting of the impacts of natural hazards on the proposed development, the potential for inappropriate development in the floodplain is greatly increased. By the time permit applications come along for construction of improvements to deeded lots, they only cover pieces of the overall land development project and may not, in and of themselves, be deniable. It is hoped that the revisions to the subdivision and zoning codes that are currently underway may serve to at least

partially remedy this deficiency, though that remains uncertain as of the development of this Plan Update.

- It is important to reiterate that the focus of the EAR's is the impact of the proposed development on the site and adjacent features with only passing emphasis placed on the potential impact of the site and its conditions on the proposed development. To be most effective, the existing EAR requirements need to be revised to include specific references (and threshold criteria of benefits and costs) to assessing vulnerability and estimating potential losses to property from natural hazards as well as the cost of emergency response and recovery operations attributable to the proposed development.

The NOAA *Final 312 Evaluation Findings of the Virgin Islands Coastal Zone Management Program* reiterated concerns about development and earth change in Tier 2 in which erosion and sedimentation is *"one of the major impacts to coastal water quality and to the long term health of the Territory's coral reefs*" (NOAA, 2003). The report goes on to indicate that situation is a very complex issue to resolve, especially on St Thomas and St. John, where a majority of land occur on slopes greater than 25%.

One of the positive aspects of the VICZMP is that a mechanism already exists for initiating the changes to the CZM process. Title 12 VIRR, Chapter 21, §912 (b) identifies a requirement for "continued planning", which states: *"[t]o ensure that the provisions of this Chapter are regularly reviewed and the recommendations for revisions of, or amendments to, the Virgin Islands Coastal Zone Management Program will be … developed, …and to provide for continued territorial coastal planning and management, the Virgin Islands Planning Office [now DPNR] shall undertake on a continuing basis such activity and research as is necessary to maintain a continued involvement in the coastal zone management process…*". This provides DPNR with the ability to make recommendations for amendments that could accommodate the recommended changes in the requirements and process.

It is necessary to note that the VICZMP has initiated changes to rules and regulations in 2006. The 2006 revisions, which are currently under review, do not refine or expand the extent of the coastal zone and/or redefine permit review or CZM commission procedures. The 2006 revisions to the rules and regulations introduce changes to administrative processes and introduce new permit fees.

### *Areas of Particular Concern*

The Coastal Zone Management Act defined Areas of Particular Concern (APC) and established criteria for selection in 15 CFR Part 923. The process should include the development of a management plan for each designated area. In part, the management plans are intended to make provisions for acceptable levels of future land development that in turn can be used to revise the zoning designations in these areas. As a result, a formidable tool is available through the APC management plans to set direction for development in these areas in advance of permit applications – i.e., taking a proactive versus reactive approach to land use and hazard mitigation. To date, eighteen areas have been designated as APCs in the US Virgin Islands. At this time of this Plan Update, draft management plans have been developed for three areas.

Evaluation / Assessment

While there is legislation in place for review of development activities in the APCs, the process will still depend on having approved management plans in place. Only a few management plans, such as the *St. Croix East End Marine Park Management Plan* (approved in 2002), have been implemented. In recent years, efforts to develop new APC plans have faded away from being a priority at DPNR agenda. The NOAA *Final 312 Evaluation Findings of the Virgin Islands Coastal Zone Management Program* have found many problems in the existing APC program and indicated that many of the APC "goals are so broad that a focusing and prioritization of goals and objectives may be necessary for the Territory to move forward with meaningful implementation". It also cited that the implementation of many of the goals rely on various territorial agencies and called for the development of a clear strategy that prioritizes APC plan development and seeks to identify partners within Territorial agencies for the implementation.

### *Coastal Barrier Resource System*

The Coastal Barrier Resources Act (16 U.S.C. 3509) (CBRA) was enacted in 1982 and established the Coastal Barrier Resources System (CBRS). The Act states that in the resulting designated areas along the Atlantic and Gulf of Mexico coastlines, *"most federal expenditures are no longer available to promote economic growth or development".* 35 different coastal areas in the US Virgin Islands, covering a total of 130 miles of the coastline and hundreds of acres of sensitive landscapes, are included in the designations.

Protection of significant areas of the coastal system have been realized although development activity in some of the watersheds have contributed to (and will continue to do so if unchecked) degradation of the resources.

Evaluation / Assessment

Protection only extends to the actual coastal barrier resource in question and not to the watershed that can adversely affect the resource. This could be addressed through more aggressive implementation of a watershed approach to land use planning, and both the quality and quantity aspects of storm water and floodplain management.

## 3.2.4.1.3 Land Development Regulations

Land development regulations play an essential role in an integrated coordinated program of hazard mitigation. By controlling where and how development occurs, major problems can be lessened or avoided. Also, as properties are redeveloped or rebuilt, strong regulations can ensure that the replacement or repaired structures are better able to resist damage from future events.

In the US Virgin Islands, there are three main elements to the land development regulations including:

- Zoning;
- Subdivision Regulations;
- Building Codes; and

- Building Permits.

### Zoning

US Virgin Islands zoning law is based on VIC Title 29, Chapter 3, Subchapter 1. The code divides all the islands into various land and water based districts as tabulated below:

**TABLE 3.1** ***Zoning Designations***

| Zoning Category | Percent of Total Area |
|---|---|
| **St Croix** | |
| Low Density Residential | 54 |
| Agricultural | 25 |
| Medium Density Residential | 7 |
| Industrial | 5 |
| Waterfront - Pleasure | 2 |
| Business / Commercial | 1 |
| Public and Other | 6 |
| **St. John** | |
| Low Density Residential | 42 |
| Medium Density Residential | 3 |
| Industrial | <1 |
| Waterfront - Pleasure | 2.5 |
| Public (National Park) and Other | 52 |
| **St Thomas** | |
| Low Density Residential | 70 |
| Agricultural | <5 |
| Industrial | <5 |
| Waterfront - Pleasure | 4 |
| Public and Other | 15 |

Evaluation / Assessment

By prohibiting or regulating development and redevelopment in hazard prone areas, zoning can be an effective means to eliminate or reduce the risk of loss of life and property damage. This is most relevant to hazards that have defined geographic extents such as flooding. Comparing the results of the hazard profiling and risk assessment from this study with the existing zoning map would help identify areas where potential development may be in harm's way. This could lead to revisions in the map that provide a better match between the suitability of the land for development and the type and intensity of use proposed.

Creating and implementing a revised zoning map that includes substantial reductions in development capacities in hazard prone areas will have immediate results in limiting future losses. Zoning can also be used to reduce density in existing developed areas. By down-zoning (i.e., reducing allowable development densities and intensities), non-conforming uses will be established. Like the current system, these uses will persist until such time as the property owners request permits for substantial changes to the property or the property is substantially improved or damaged (i.e., at a level greater than 50 percent of its value). In these cases, provisions can take effect that reduces hazard vulnerability and / or the property cannot be redeveloped.

DPNR is in the process of revising the US Virgin Islands zoning regulations. The current revisions do not change the zoning map or zoning designations, but will serve to bring the zoning code up to current standards and provide more flexibility in development review procedures by reducing the need for extensive use of variances. The revisions should be ready for public and legislative review and comment by early summer 2014, and is intended to create a more streamlined, enforceable zoning process. It is DPNR's intent, based on the recommendations of the Rutgers and Duncan Associates study (discussed earlier in this section), to draft and adopt new land use and zoning legislation that defines a set of prescriptive rules and regulations to support the existing land uses and to promote the desired future development patterns in order to maintain the health, safety and welfare of the community over time.

### *Subdivision Regulations*

The main issues related to the subdivision regulations in the US Virgin Islands (as contained in Title 29, Chapter 3, Subchapter 231 of the VIC) are as follows:

- Minor division of land (i.e., development proposals with less than 4 lots) is not considered a subdivision under the US Virgin Island Code and is reviewed by the Chief Surveyor, working under the Lt. Governor's Office. While there are some requirements addressing flood prevention, there are no clearly enforceable complimentary storm water management provisions for these minor subdivisions. However, in the aggregate, all development on a relatively small and closed system like the US Virgin Islands will have some level of impact on storm water runoff and, therefore can detrimentally influence the effectiveness of programs intended to reduce non-point source pollution, protect coastal resources, and mitigate flooding.

- Subdivisions with 4 lots and greater are reviewed by a representative of the DPNR, Division of Comprehensive and Coastal Zone Planning (CCZP). However, for subdivisions in Tier 1, the applicant only needs to address the requirements for a minor CZM permit. The problems with this approach have been discussed previously under the CZM Program section. With no set review criteria, no substantial storm water management regulations, and no formal process for bringing in environmental expertise from other relevant DPNR divisions, it is difficult to influence the way development is planned and implemented in the US Virgin Islands to reduce exposure and risk.
- Basic engineering practices related to land development need to be better incorporated into the subdivision regulations. For example, under the current regulations, it is possible to build roads in the Special Flood Hazard Area with elevations up to two (2') feet below the regulatory flood elevation. In practice, what this can and does result in is the road becomes a conveyance for storm water, promoting unsafe conditions and promoting damage to the roadway that must be repaired by the Territory after major storm events.
- DPNR can take greater advantage of innovative subdivision design and siting techniques than currently allowed under the existing subdivision regulations or proposed revisions by requiring or providing better incentives for cluster development, open space preservation, density-bonuses, setbacks, overlay zoning techniques (described earlier), and special considerations for developments in coastal high hazard areas (for more information on these innovative techniques the interested reader is referred to the FEMA/APA Planning Advisory Service Report # 473 entitled, Subdivision Design in Flood Hazard Areas, 1997).

It is necessary to note that DPNR and the Division of Environmental Protection has implemented a regulation requiring all applicants submitting documents and plans for construction or earth change permits, for developments one acre or greater, to submit a storm water prevention plan. The storm water prevention plan must take into account pre-existing hydrology as well as postulate on post construction run-off. The storm water prevention plan must also clearly indicate how mitigation measures will be introduced in the site design. This action has potential to be an effective strategy to ensure that surface run-off does not exceed pre-existing conditions and may assure that future development does not exacerbate flooding in downstream areas.

At the time of this Plan Update, the subdivision regulations were in the same revision process as the zoning codes.  These revisions should also be completed by mid-2014, and are also expected to produce subdivision regulations that are easier to understand, interpret and enforce, that incorporate new technology and new ways of thinking about subdivision zoning, and that create a path for the development of a comprehensive land use plan, which does not currently exist in the US Virgin Islands.

### Building Codes

An effectively administered and enforced building code can literally save lives. For current use the US Virgin Islands has adopted and enacted the International Construction Standards. These include:

- International Building Code (IBC) - Pertains to the construction of commercial and multi dwelling buildings.
- International Residential Code (IRC) – Regulates the construction of single and two family dwellings.
- International Mechanical Code (IMC) – Establishes standards for electrical, plumbing and air quality systems.
- International Energy Conservation Code (IECC) – Pertains to the standards for energy efficient structure construction

These codes established by the International Code Council contain specific references to hazard mitigation. A consistent enforcement of these construction codes should result in a significant reduction of property loss especially from the hazards of windstorm, earthquake and fire.

Evaluation / Assessment

The implementation of the IBC, while a good step for the Territory, has met mixed results. In the evaluation for the Plan Update, DPNR has indicated that the local developers and architects have adopted and followed the IBC guidelines fairly well. The implementation of the IBC has fallen short; however, due to staff limitations and lack of resources. This area needing improvement is discussed further in the following sub-section.

### Building Permits

A measure of the enforcement of building codes is the number and type of building permits issued. The following tables illustrate the number and type of building permits issued and inspections performed throughout the USVI from FY2008 – FY2010, as well as the estimated value of new construction resulting from these permits and inspections.

**TABLE 3.2** ***Building Permit, Inspection and New Construction Data - FY2008***

| Permit Applications | St. Thomas Received | St. John Received | St. Croix Received | Total Received | STT/STJ Approved | STX Approved | Total Approved |
|---|---|---|---|---|---|---|---|
| Flood Plain | 1 | 0 | 35 | 36 | 1 | 40 | 41 |
| Plan Review | 299 | 105 | 528 | 932 | 262 | 315 | 577 |
| Demolition | 8 | 1 | 22 | 31 | 5 | 23 | 28 |
| Building | 475 | 84 | 410 | 969 | 226 | 312 | 538 |
| Plumbing | 211 | 63 | 300 | 574 | 206 | 285 | 491 |
| Electrical | 422 | 68 | 487 | 977 | 422 | 445 | 867 |
| Use and Occupancy | 156 | 69 | 252 | 477 | 263 | 237 | 500 |
| Sign | 2 | 0 | 0 | 2 | 1 | 0 | 1 |

| Site Inspections | St. Thomas Requested | St. John Requested | St. Croix Requested | Total Requested | STT/STJ Approved | STX Approved | Total Approved |
|---|---|---|---|---|---|---|---|
| Flood Plain | 1 | 0 | 26 | 27 | 1 | 14 | 15 |
| Plan Review | 106 | 41 | 55 | 202 | 108 | 59 | 167 |
| Building | 1035 | 558 | 1105 | 2698 | 1496 | 1089 | 2585 |
| Plumbing | 339 | 237 | 712 | 1288 | 519 | 749 | 1268 |
| Electrical | 615 | 243 | 830 | 1688 | 858 | 1125 | 1983 |
| Violation | 84 | 2 | 46 | 132 | 82 | 46 | 128 |
| Site Visit | 1003 | 84 | 73 | 1160 | 1182 | 113 | 1295 |

| Estimated Construction Cost | St. Thomas | St. John | St. Croix | Total |
|---|---|---|---|---|
| New Construction | $137,567,534 | $18,460,796 | $92,301,398 | $248,329,728 |

**TABLE 3.3** ***Building Permit, Inspection and New Construction Data – FY2009***

| Permit Applications | St. Thomas Received | St. Thomas Approved | St. Thomas Issued | St. John Received | St. John Approved | St. John Issued | St. Croix Received | St. Croix Approved | St. Croix Issued |
|---|---|---|---|---|---|---|---|---|---|
| Flood Plain | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 33 | 26 |
| Plan Review | 158 | 118 | 91 | 55 | 40 | 38 | 509 | 432 | 388 |
| Demolition | 11 | 6 | 5 | 0 | 0 | 0 | 29 | 28 | 24 |
| Building | 418 | 256 | 180 | 75 | 22 | 18 | 485 | 457 | 391 |
| Plumbing | 215 | 167 | 220 | 50 | 29 | 20 | 335 | 225 | 221 |
| Electrical | 401 | 317 | 171 | 56 | 43 | 29 | 409 | 424 | 411 |
| Use and Occupancy | 153 | 147 | 135 | 46 | 39 | 39 | 247 | 210 | 188 |
| Restoration (Hurricane) | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 0 |
| Total | 1356 | 1011 | 802 | 282 | 173 | 144 | 2041 | 1809 | 1649 |

| Inspections | St. Thomas | | St. John | | St. Croix | |
|---|---|---|---|---|---|---|
| | Received | Performed | Received | Performed | Received | Performed |
| Flood Plain | 0 | 0 | 0 | 0 | 3 | 0 |
| Plan Review | 119 | 131 | 45 | 32 | 39 | 39 |
| Building | 842 | 1112 | 445 | 419 | 1099 | 782 |
| Plumbing | 313 | 280 | 220 | 229 | 676 | 695 |
| Electrical | 545 | 746 | 316 | 299 | 970 | 1411 |
| Violation | 153 | 172 | 8 | 7 | 22 | 80 |
| Site Visit | 1213 | 1507 | 31 | 40 | 44 | 44 |
| Restoration | 0 | 0 | 0 | 0 | 21 | 20 |
| Total | 3185 | 3948 | 1065 | 1026 | 2874 | 3071 |

| Estimated Construction Cost | St. Thomas | St. John | St. Croix | Total |
|---|---|---|---|---|
| New Construction | $63,989,406 | $6,358,632 | $124,472,981 | $194,821,018 |

**TABLE 3.4 *Building Permit, Inspection and New Construction Data – FY2010***

| Permit Applications | St. Thomas Received | St. Thomas Approved | St. Thomas Issued | St. John Received | St. John Approved | St. John Issued | St. Croix Received | St. Croix Approved | St. Croix Issued |
|---|---|---|---|---|---|---|---|---|---|
| Flood Plain | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 16 | 15 |
| Demolition | 14 | 5 | 4 | 3 | 3 | 3 | 35 | 39 | 33 |
| Building | 355 | 251 | 213 | 54 | 44 | 30 | 469 | 432 | 418 |
| Plumbing | 152 | 158 | 93 | 23 | 22 | 12 | 262 | 256 | 240 |
| Electrical | 315 | 275 | 181 | 54 | 46 | 31 | 490 | 449 | 437 |
| Use and Occupancy | 148 | 151 | 142 | 30 | 34 | 32 | 273 | 262 | 226 |
| Total | 984 | 840 | 633 | 164 | 149 | 108 | 1540 | 1454 | 1369 |

| Inspections | St. Thomas | | St. John | | St. Croix | |
|---|---|---|---|---|---|---|
| | Received | Performed | Received | Performed | Received | Performed |
| Flood Plain | 0 | 0 | 0 | 0 | 0 | 0 |
| Building | 807 | 883 | 633 | 587 | 1175 | 996 |
| Plumbing | 307 | 315 | 192 | 181 | 667 | 632 |
| Electrical | 601 | 599 | 202 | 202 | 987 | 1204 |
| Violation | 77 | 77 | 16 | 16 | 20 | 19 |
| Site Visit | 693 | 693 | 55 | 55 | 39 | 39 |
| Total | 2485 | 2567 | 1098 | 1041 | 2888 | 2890 |

| Estimated Construction Cost | St. Thomas | St. John | St. Croix | Total |
|---|---|---|---|---|
| New Construction | $63,328,779 | $8,426,109 | $92,917,843 | $164,672,730 |

Evaluation / Assessment

As evidenced in the tables above, the total value of new construction in the USVI declined significantly from FY 2008 through FY 2010. Approved building permits also declined significantly during this three year period; dropping by 120 from 538 approved permits for FY 2009 (22% decline). Although similar data is not readily available for the past three years, it is assumed that a similar pattern of decline occurred due to recent economic conditions on the islands.

DPNR lacks the appropriate staff and resources to resolve technical challenges, particularly in areas of development plan review and enforcement. Adequate staffing is a serious impediment to the effective implementation of the program. In addition, the department could benefit greatly from an investment in GIS technology and staffing, dedicated to facilitating the permitting and review process. Such an investment could also serve to monitor hazard mitigation concerns related to permitting, including permit location within the SFHA and identification of steep grade or seismic concerns.

### 3.2.4.2 Post-Disaster Hazard Mitigation

Programs, rules and regulations that are focused primarily or substantially on post-disaster hazard mitigation in the US Virgin Islands include:

**Emergency Management Council**

The Emergency Management Council was established by Executive Order Number 304-1987 under the US Virgin Islands Code (Title 23, Chapter 12, Section 1126a). The order established the Council which sets the basic framework for the Territory's participation in the Federal Disaster Assistance Program.

**Flood Hazard Mitigation Plan**

The Flood Hazard Mitigation Plan (completed in 2000 and adopted in 2003) was discussed previously as part of the pre-disaster hazard mitigation programs in the US Virgin Islands. The Plan also includes a number of recommendations that are intended to improve the post-disaster hazard mitigation related capabilities in the Territory including improved flood forecasting / disaster warning systems, disaster preparedness and post-flood recovery activities.

**FEMA Disaster Management Guide**

The FEMA Disaster Management Guide for the US Virgin Islands, FEMA Region II CAO (2004) provides the broad comprehensive disaster management guidance that is still pertinent today.

### 3.2.4.3 Other Related Programs

Programs, rules and regulations that have provisions or aspects that could support hazard mitigation in the US Virgin Islands include:

**Unified Watershed Assessment and Restoration Priorities Program**

The DPNR, in cooperation with the US Department of Agriculture and its Natural Resources Conservation Service has developed the Unified Watershed Assessment Report pursuant to the Territory's Clean Water Action Plan. An important element of the Action Plan is to undertake a cooperative process for restoring and protecting water quality on a watershed basis. DPNR identified problem watersheds that were not meeting, or were in danger of not meeting, clean water or other natural resource goals. The assessments were prepared using existing information and were a collaborative effort between local government, federal land management agencies, conservation districts and land conservation departments, non-governmental and private organizations and other stakeholders.

The watershed approach and the collaborative model for public and private partnerships would be conducive to much of the work that needs to be done to implement a comprehensive hazard mitigation strategy. However, the implementation of these programs has been stymied by lack of adequate staffing and resources. Enforcement of erosion and sediment control should become priorities for DPNR, particularly as it relates to reducing surface run-off and flood hazard reduction along with water quality protection.

**Environmental Programs**

In a similar manner, various efforts of the Territory, including:

- Non-Point Pollution Control Program;
- Sediment Reduction Program; and
- Protection of Endangered Species,

All have aspects that can and should be coordinated with an overall effort to promote hazard mitigation. As more and more elements of the Territory's planning efforts become integrated, the result will be increased effectiveness and efficiency of the programs, as well as, increased sustainability for the Territory.

#### 3.2.4.4 Proposed Programs

No major new proposed programs were identified that are currently underway during the development of this Plan Update that has direct relevance to VITEMA hazard mitigation program elements.

## 3.3 FUNDING

### 3.3.1 FEDERAL FUNDING

Section 2.4 of this Plan Update identified some of the key programmatic changes to FEMA's hazard mitigation programs over the past three years; this section provides additional details on how these changes would affect future funding of hazard mitigation in the Territory. Clearly, the Territory should take maximum advantage of HMA grant programs in both pre- and post-disaster settings.

For the purposes of the Plan Update, the following description of federal funding sources is limited to programs with direct or indirect relationship to hazard mitigation. Through the Federal Emergency Management Agency (FEMA), the Federal government has several programs to support hazard mitigation. These programs are federally-funded and are administered by the Virgin Islands Territorial Emergency Management Agency (VITEMA).

- FEMA Pre-Disaster Mitigation Program: The Pre-Disaster Mitigation (PDM) program is designed to implement cost-effective hazard mitigation activities that complement a comprehensive mitigation program. These include planning, acquisition, retrofitting, flood control projects, generators, and other projects. All applicants must participate in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area. Only governments are eligible. PDM covers up to 75% of costs.
- FEMA Hazard Mitigation Grant Program: Authorized under Section 404 of the Stafford Act, the Hazard Mitigation Grant Program (HMGP) is funded by FEMA and administered by VITEMA, and provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation

measures to be implemented during the immediate recovery from a disaster. Eligible projects include drainage systems, structure elevation, landscape alteration, floodwalls, road elevation, property acquisition, development of mitigation plans, development of land-use regulations, and more. Governments and selected non-profits are eligible. HMGP covers up to 75% of costs. Note that there are 10 projects that have been funded by this source following DR-1807 and are included in the 2011 Hazard Mitigation Strategy.

- FEMA Flood Mitigation Assistance Program: The Flood Mitigation Assistance (FMA) program's goal is to reduce or eliminate claims under the NFIP. FMA provides funding to assist States and NFIP-participating communities in implementing plans, projects, and programs to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. This includes acquisition, elevation, flood mitigation, and more. FMA covers up to 75% of costs. For those States and Territories with an approved SRL strategy in the SHMP, the Federal cost share may be increased.
- FEMA Public Assistance: The PA Program provides supplemental Federal disaster grant assistance under Section 406 of the Stafford Act for the mitigation of disaster-damaged, publicly owned facilities and the facilities of certain private, non-profit organizations. Eligible projects include: elevation, flood proofing or relocation of damaged elements during the repair process, and more. PA covers up to 75% of costs, though an increased Federal share can be requested.
- FEMA Unmet Needs: FEMA's Unmet Needs program is authorized by Congress for specific major disaster related events where the needs of the citizens are not met through existing services. The Unmet Needs program is implemented only when deemed appropriate by Congress. Project eligibility is also determined by Congress, but will usually conform to the existing criteria under the HMGP unless specifically waived.

As noted in Section 2.4, the Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims and Severe Repetitive loss grant programs. To encourage efforts by states and local jurisdictions, FEMA has changed the cost-share requirements to allow more Federal funds for properties with repetitive flood claims and severe loss properties. Implementing flood mitigation measures for severe repetitive loss properties would be funded by FEMA at 100 percent; and, funding for implementation of flood mitigation measures for repetitive loss properties would be funded at 90 percent. Given the stark economic reality in the USVI over the past six years, focusing the mitigation strategy on addressing repetitive losses is the best option for the USVI Territory.

Several other aspects of the HMA Unified Guidance that are relevant to Federal funding of hazard mitigation in the USVI include:

- Advance Assistance: This funding option applies only to HMGP. Up to 25 percent of the HMGP Ceiling with a cap of $10 million can be used to obtain data to prioritize, select, and develop complete HMGP applications. This is not automatic and the Territory would have to request this option by submitting a brief request for Advance Assistance. This option will

be very important for the Territory, as there will be limitations on the amount of pre-disaster planning for long-term recovery that the USVI can undertake under the current economic climate.

- Planning Grants: There is no longer the restriction that a planning grant can only be awarded not more than once every 5 years to a State or Territory.
- Five Percent Initiative: Up to 5 percent of the total HMGP funds may be set aside by the Grantee to pay for a range of activities that are difficult to evaluate against traditional cost effectiveness criteria. There would have to be a reasonable expectation that future damages or loss of life would be reduced or prevented should the 5 percent Initiative be undertaken. VITEMA intends to take full advantage of the 5 Percent Initiative because of the problems associated with a sufficient historical database of disaster-related damages needed to conduct benefit/cost analysis.

Part II of the HMA Unified Guidance discusses "frontloading" HMA program requirements by States or Territories. This new guidance encourages Applicants to conduct adequate scoping and project development prior to submitting HMGP, PDM or FMA grant applications. Scoping would involve conceptualizing project alternatives that would also meet the purpose and need of the proposed project. By evaluating technical feasibility, cost effectiveness and environmental or cultural resource considerations early in project formalization, it will facilitate, expedite and lead to more successful implementation of hazard mitigation projects.

### 3.3.2 GOVERNMENT OF THE VIRGIN ISLANDS FUNDING

Although the US economy has seen slow but sustained growth from 2011 through 2014, the USVI suffered a major economic impact when the HOVENSA LLC petroleum refinery on St. Croix closed in January of 2012. Over 2,000 well-paid, full-time positions were lost; 1,200 refinery positions, more than half of the manufacturing sector, along with 950 full-time jobs associated with subcontractors. For the years when the refinery was in operation, the USVI economy was somewhat immune to the oscillations of the US economy; however with its closure, the USVI will be more subject to the mainland economic cycles. Future economic growth in the USVI is quite uncertain and the financial challenges are expected continue to persist for the next three year phase.

From FY2008 to FY2010, the Government of the Virgin Islands has experienced asymmetrical oscillations in its fiscal sector. In the 2011 State of the Territory Address, the Territorial Governor discussed the 30% decrease in General Funds revenues each year in 2009 and 2010, which was only partially offset by the $288 million in Recovery Act spending that the Territory received during the same time period. During a three-year period from 2008 through 2010, the General Fund experienced a $660 million budget shortfall, which is the equivalent of almost 60% of the government salaries in the Territory during the same time period. Governor deJongh went on to discuss his belief that the Territory is at a "tipping point," and that serious reductions in government spending must occur; he indicated his position that a 30% reduction was the bare bones reduction to begin to address this deficiency.

The precarious financial position portends that, in all likelihood, the US Virgin Islands government would face a difficult challenge in implementing mitigation actions with Territorial cost share requirements of greater than 10 percent (many FEMA grant programs are 75% Federal / 25% State or Local; USACE programs for structural flood control projects are often set at 50% Federal / 50% State or Local).

Under these present and anticipated near term financial conditions for the Government of the Virgin Islands, adequate operating budgets to implement hazard mitigation actions will be severely constrained. In the case of retrofitting critical facilities or undertaking structural mitigation projects, the financial reality over the next three to five years, implies a heavy reliance on Federal funding sources, and pursuing hazard mitigation program opportunities where a lower cost share for the USVI Government are available . However, many of the programmatic mitigation actions (Territory-wide) recommended in the 2011 Plan and again in this Plan Update, can be implemented at low cost to the US Virgin Islands government and could achieve substantial returns in a more sustainable and resilient future for the islands.

Many of the refinements to development regulations and improved administrative procedures proposed can be implemented through existing or augmented annual departmental operating budgets. These revisions and refinements are expected to significantly increase the ability of the Territory to effectively mitigate known hazards.

### 3.3.3 OTHER FUNDING SOURCES

Given the current and anticipated financial position of the US Virgin Islands, departments charged with implementing "soft or hard" mitigation actions will need to be creative and innovative in seeking adequate funding. Some innovative approaches that have proved fruitful elsewhere include:

- Encouraging the active participation of the private sector, pursuing non-profit funding opportunities (such as private foundations),
- Seeking other Federal grants not related to comprehensive emergency management (CDBG, Economic Development Administration, USDA rural development grants, etc.),
- Strengthening partnerships with UVI, the Chamber of Commerce, voluntary relief and other civic organizations, and
- Continued outreach to construction, tourism and insurance sectors of the economy.

## 3.4 ANALYSIS AND EVALUATION OF THE EFFECTIVENESS OF MITIGATION PROGRAMS AND ACTIVITIES

Many of the general observations of this Plan Update are consistent with those of the previous plan development. The findings of the capability assessment interviews fall into three broad categories: (1) funding – local fiscal constraints; (2) inadequate staffing; and, (3) need to enhance technical capabilities. The issue of having an adequate annual operating budget to implement specific department mandates, let alone mitigation actions or programs, was raised as a critical concern by many departmental representatives interviewed.

The section below outlines mitigation program or project activities, Virgin Islands Department, Agency and Authority responsibilities for implementation of hazard mitigation and staffing and technical capability concerns.

### 3.4.1 ADMINISTRATIVE CAPABILITIES TO IMPLEMENT HAZARD MITIGATION

To fully assess the Virgin Islands capabilities to support hazard mitigation, VITEMA completed a history of the last ten years. The data is broken out to document mitigation activity since the 2005 Plan. All Mitigation Activities funded by HMGP, FMA and PDM were reviewed.

#### 3.4.1.1 Pre-Disaster Grant Administration

The process for identify the history of FMA and PDM mitigation projects in the USVI over the past ten years.

**TABLE 3.2** ***Flood Mitigation Assistance and Pre-Disaster Mitigation Grant Projects in the US Virgin Islands***

| FISCAL YEAR | Grant Number | Grantee/ Sub-Grantee | Project Title | Federal | Non-Federal | Total Project |
|---|---|---|---|---|---|---|
| **Flood Mitigation Assistance Program** | | | | | | |
| **FY 2004** | FMA-PJ-02-VI-2004 (0) | VITEMA/DOE | **Central High Flood Mitigation Project** The project consist of the construction and installation of new 3'0"x3'0" concrete manholes, cut and remove sections of the existing drain pipes to accommodate for the new inlet manholes. | $115,000.00 | $0.00 | $115,000.00 |
| **FY 2004** | FMA-TA-02-VI-2004 (0) | VITEMA | **St. Croix Central High School Flood Mitigation Project** Technical Assistance to manage the FMA to implemented through the VITEMA office to ensure the accuracy of the project | $15,000.00 | $0.00 | $15,000.00 |
| **FY 2005** | FMA-PJ-02-VI-2005 (0) | VITEMA/DPW | **St. Andrews Episcopal Church Flood Mitigation Project - St. Thomas, USVI** Minimize repetitive flooding of St. Andrews Episcopal Church and surrounding community. It will increase the intake capacity of the existing box culver adjacent to the church and along Sixth Street near the intersection of F | $115,900.00 | $0.00 | $115,900.00 |

| FISCAL YEAR | Grant Number | Grantee/ Sub-Grantee | Project Title | Federal | Non-Federal | Total Project |
|---|---|---|---|---|---|---|
| Pre-Disaster Mitigation Program | | | | | | |
| FY 2006 | PDMC-PJ-02-VI-2006-001 (0) | VITEMA/WAPA | **Christiansted Electrical Distribution System Mitigation Project** Mitigate and restore the electrical distribution system. Bury distribution lines of the feeder (Feeder No. 1) and replace existing pole mounted transformers with pad-mounted transformers. | $2,758,927.51 | $920,000.00 | $3,678,927.51 |
| FY 2007 | PDMC-PL-02-VI-2007-001 (0) | VITEMA/VITEMA | **USVI State Hazard Mitigation Plan Comprehensive Review and Update** VITEMA will be updating its existing multihazard mitigation plan to comply with FEMA's regulation requiring that State Mitigation Plans be updated and submitted to FEMA for approval every 3 years in order to continue eligibility for non-emergency Stafford Act assistance. | $187,500.00 | $62,500.00 | $250,000.00 |
| FY 2007 | PDMC-PJ-02-VI-2007-005 | VITEMA/WAPA | **St. Thomas Underground electrical Distribution Mitigate and restore the electrical distribution system. Bury distribution lines of the feeder and replace existing pole mounted transformers with pad-mounted transformers.** | $1,632,469.83 | $547,935.98 | $2,180,405.81 |
| FY 2007 | PDMC-PJ-02-VI-2007-006 | VITEMA/WAPA | **Charles Harwood Memorial Hospital Electrical Underground Mitigate and restore the electrical distribution system at hospital by burying distribution lines, etc.** | $407,647.29 | $135,882.43 | $543,529.72 |
| FY2007 | PDMC-PJ-02-VI-2007-007 | VITEMA/WAPA | **Christiansted Electrical Distribution System Mitigation Project Phase II Mitigate and restore the electrical distribution system. Bury distribution lines of the feeder and replace existing pole mounted transformers with pad-mounted transformers.** | $2,381,856.59 | $793,952.20 | $3,175,808.79 |

### 3.4.1.2 Post-Disaster Project Administration

The process for identify the history of HMGP mitigation projects in the USVI over the past ten years.

**TABLE 3.3** ***Hazard Mitigation Grant Program Projects in the US Virgin Islands***

| Disaster Number | Applicant/Project Name | Total Project Cost Estimated | Total Approved Net Eligible Project Cost | Federal Share | Non Federal |
|---|---|---|---|---|---|
| | | | | | |
| 1503 | **Virgin Islands Department of Education/** Upgrade Existing storm water system to Pearl B. Larsen School in St Croix, VI. | $38,220 | $38,220 | $37,700 | $0.00 |
| 1567 | **Virgin Islands Department of Education/**Installation of Shutters at the Oliver Benjamin School Shutters in St Thomas. Acquisition and Installation of RE-60 rollup shutters to protect the Benjamin School Cafeteria and Library Storefront. | $113,870 | $113,870 | $113,870 | $0.00 |
| 1807 | **Department of Property and Procurement/** Hurricane High Impact Windows (STT) | $466,667 | $466,667 | 350,000.25 | $116,666.75 |
| 1807 | **Department of Public works/** Hurricane High Impact Windows (STT) | $146,667 | $146,667 | $110.000.25 | $36,666.75 |
| 1807 | **Department of Human Services/** Hurricane High Impact Windows (STT) | $192,414 | $192,414 | $144,310.50 | $48,103.50 |
| 1807 | **Department of Education/** Hurricane High Impact Windows (STT) | $32,467 | $32,467 | $24,350.35 | $8,1116.75 |
| 1807 | **American Red Cross/** Storm Shutters (STX) | $64,509.33 | $64,509.33 | $48,382.00 | $16,127.33 |
| 1807 | **Virgin Islands Fire Service (Emilie Henderson)/** Storm Shutters (STX) | $18,467.00 | $18,467.00 | $13,850.25 | $4,616.75 |
| 1807 | **Virgin Islands Fire Service (Renceliar Gibbs)/** Roll-up Doors (STX) | $22,916.00 | $22,916.00 | $17,187.00 | $5,729.00 |
| 1807 | **Virgin Islands Port Authority/ Henry E. Rohlsen/** Fabric Shutter System (STX) | $236,044.00 | $236,044.00 | $177,033.00 | $59,011.00 |
| 1807 | **Department of Health (DeCastro Clinic)/**Storm Shutters (STJ) | $21,305.33 | $21,305.33 | $15,979.00 | $5,326.33 |
| 1939 | **Water and Power Authority (WAPA)**Wind Retrofitting of the Pad Mounted Transformers on St Croix (Replacing large pole mounted transformers banks with pad mounted transformers at local elementary schools in STX. | **$315,000** | **$315,000** | **$236,250** | **$78,750** |
| 1939 | **VI Fire Service** Roll Up Doors at Emile Henderson Fire Station | **$43,509** | **$43,509** | **$32,632** | **$10,877** |
| 1948 | **Water and Power Authority (WAPA)**Wind retrofitting of Pad Mounted Transformers | **$307,052** | **$307,052** | **$230,289** | **$76,763** |
| 1949 | **Water and Power Authority (WAPA)**Replacement of three phase transclosures with pad mounted transformers, St. Croix | **$499,255** | **$499,255** | **$374,441** | **$124,814** |

### 3.4.2 US Virgin Islands Departments, Agencies and Authorities

As part of a study entitled "*Mitigating the Impact of Natural Hazards in the US Virgin Islands*" (IRF, 1995), the major agencies and utilities of the US Virgin Islands responded to a questionnaire regarding their perceived role in hazard planning and mitigation activities. The following matrix is still valid as the Government portfolio and responsibilities of agencies have not changed since the 2005 Plan.

**TABLE 3.4** ***Primary and Secondary Mitigation Responsibilities of Agencies in the US Virgin Islands***

| | VITEMA | DPNR | DPW | Fire Service | Police | Tourism | OMB | P&P | Port Authority | WAPA |
|---|---|---|---|---|---|---|---|---|---|---|
| **Planning / Management Issues** | | | | | | | | | | |
| Acquisition | | S | | | | | S | P | | |
| Location of Public Buildings | | S | | | | | | | | |
| Warning Systems | P | | | P | P | | | | | |
| Flood / Hazard Insurance | | P | | | | | | | | |
| Disaster Loans and Grants | | | | | | S | S | | | |
| Education / Public Information | P | S | | | | S | | S | | |
| Demarcation of Hazard Areas | S | P | | S | | | | | | |
| Building / Health Code Revisions | | | P | | | | | | | |
| Inspection Programs | | P | P | S | | | | | | |
| Floodplain Easements | | P | P | | | | | P | | |
| Floodplain Regulation | | P | | | | | | | | |
| Hazard Risk Assessment | S | | | S | | | | P | | |
| Development Restrictions | | P | | | | | | | | |
| Hazard Disclosure Regulation | | S | | P | | | | S | | |
| Zoning Regulations | | P | | | | | | | | |
| Wetland Regulations | | P | | | | | | | | |
| Acquisition of Development Rights | | P | | | | | S | P | | |
| Areas of Particular Concern | | P | | | | | | | | |
| Open Space Planning | | P | | | | | | | | |
| Relocation | | | P | | | | | | | |
| Special Fees and Taxes | | S | | | | | S | S | | |
| Hazard Monitoring | P | S | P | P | | | | S | P | P |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Flood Proofing | | | P | | | | | P | | |
| Preparedness Planning | P | S | P | P | | S | S | | | P |
| **Structural Issues** | | | | | | | | | | |
| Flood Proofing, Gut Maintenance | | | | | | | | | | |
| Preparedness Planning | P | P | | | | | | | | |
| Stormwater Systems | | | P | | | | | | | |
| Modify Structures | | | P | | | | | P | | P |
| Breakwaters, Bulkheads, etc. | | S | | | | | | S | P | |
| Shore Protection Measures | | S | | | | | | S | S | |
| On-Site Detention / Dams | | S | P | | | | | S | | |
| Channel Modifications / Culverts | | S | P | | | | | S | | |

**Legend**

P = Perceived primary responsibility
S = Perceived secondary responsibility

It may not always be clear which agency is responsible for taking the lead role, and which department exists under, or works closely with, which agency. The following shows the relationship between Departments and Agencies:

US Virgin Islands Departments and Agencies

- Virgin Islands Territorial Emergency Management Agency (VITEMA)
- Department of Planning and Natural Resources (DPNR), including the Divisions of Permits (DOP) and Subdivisions; Coastal Zone Management; Environmental Protection; and Fish and Wildlife.
- Department of Agriculture
- Department of Education
- Department of Public Works
- Office of Management and Budget

US Virgin Islands Committees

- Hazard Mitigation Monitoring and Evaluation Committee
- Hazard Mitigation Committees
- Coastal Zone Management Commission Committees
- Non-Point Source Pollution Steering Committee

University of the Virgin Islands (UVI) Departments

- UVI Cooperative Extension Service
- UVI Center for Marine and Environmental Studies
- Virgin Islands Conservation Data Center of the Eastern Caribbean Center of UVI
- Water Resources Research Institute

As a result, it is evident that several departments, agencies and authorities in the US Virgin Islands continue to have existing and potential roles in the implementation of the updated 2014 Virgin Islands Territorial Hazard Mitigation Plan.

## 3.4.3 STAFFING

As previously stated, VITEMA, DPNR and DPW are the key governmental agencies that have the primary responsibility for the development and implementation of Hazard Mitigation in the Territory. This is particularly true for Floodplain Management, Environmental Planning and Permitting, Building Code Enforcement, Coastal Zone Management, and Capital Improvement Projects.

While each of these agencies is tasked with the success of territorial hazard mitigation, each agency presently is overwhelmed with the implementation of its core program or department mandates. Faced with the budgetary constraints of the central government and the uncertainty future general revenues, each of these agencies has need for additional staffing to be fully able to address the concerns of Hazard Mitigation. Each agency has numerous unfilled positions making full compliance with the program mandates almost untenable. The lack of essential personnel and insufficient experience exacerbates both compliance and enforcement. The problem is most critical in DPNR, which oversees the divisions of Coastal Zone Management, Permits and Subdivisions, Fish and Wildlife and Environmental Protection.

This situation is likely to persist throughout the life of this revision period. Even though each agency is insufficiently staffed, each agency, as well as the administration of the central government, have the dedication to, and the concern for, the mandates of the Virgin Island Territorial Hazard Mitigation Plan and will actively pursue its implementation.

For VITEMA, consideration should be given to increasing the Mitigation Planning staff structure. The following organizational chart shows, as suggested in the previous Plan Update (2011), to be one possible way staff could be increased and organized to better manage the hazard mitigation planning and project needs of the Territory.


For DPNR, a serious need for qualified GIS staff exists, which will allow for a more thorough and more effective permitting process. Since 2011, all inspectors will be certified by the International

Code Council and will be required to maintain that certification through the completion of CEUs. This is expected to result in a better trained, better qualified workforce. Serious consideration is also being given to increasing the number of Certified Floodplain Managers (CFMs) in the DPNR, as this will also result is better floodplain management throughout the Territory.

### 3.4.4 TECHNICAL CAPACITY

The evaluation for this Plan Update highlighted the urgent need for data collection and management of hazard information. Currently there are very limited technical capabilities in the Territory.

VITEMA has limited technical data management capabilities. Most critical, is the need for archiving and managing data related to hazards and/or hazard mitigation programs. VITEMA presently does not have a dedicated staff person for the collection and archiving hazard plans or studies (i.e. hurricane plans, earthquake plans, riverine and coastal flood plans). The collection of such information would facilitate a more thorough assessment of the hazards such as the location of events, previous occurrences within the Territory, and facilitate a better prediction of probability of future events. This would also facilitate a more comprehensive assessment of hazards and risk.

The technical capabilities for the implementation of hazard mitigation programs and plans also remain weak. While VITEMA has maintained its capabilities for the implementation of hazard mitigation programs and plans since the 2011 Plan; most of the staff are relatively new and have limited experience in hazard mitigation. For many, the most recent disaster declaration is their first real exposure to hazard mitigation issues, programs and plans. VITEMA staff, therefore, must continue to require extensive training in hazard mitigation concepts (i.e. flood plain management, benefit-cost analysis, etc.) as well as hazard mitigation grant support (i.e. grant writing, project and application development and review, accounting and financial reporting, etc.).

## 3.5 SUMMARY AND RECOMMENDATIONS

This section points the way to specific recommendations to be included in the mitigation strategy: The first table relates Territorial plans / programs / regulations to the relevant IFR requirements and assesses effectiveness in supporting hazard mitigation. The second table provides a summary of important "gaps" in the Territory's capabilities and recommendations to address the gaps.

### 3.5.1 REGULATORY COMPLIANCE WITH DMA 2000

Section 3.1 identified the basic requirements of the IFR for Capability Assessments. Key components of those requirements ask to what extent the Territory's policies, programs and capabilities support:

- Pre-disaster hazard mitigation;
- Post-disaster hazard mitigation; and
- Regulation of development in hazard-prone areas

The findings of the evaluation for this Plan Update illustrate that the US Virgin Islands' capabilities to address hazard mitigation has not changed since the development of the 2011 Plan. Many of the requisite tools are currently in place or are continuing to evolve. Therefore, the Virgin Islands have not reached its full potential to support hazard mitigation.

**TABLE 3.5** ***Regulatory Compliance with DMA 2000***

| Description | Pre-Disaster Hazard Mitigation | Post-Disaster Hazard Mitigation | Regulation Development |
|---|---|---|---|
| **General Plans and Policies** | | | |
| Coastal Zone Management Plan | 1 | 1 | 1 |
| Comprehensive Land Use Planning | 1 | 1 | 1 |
| **Pre-Disaster Hazard Mitigation Plans, Rules and Regulations** | | | |
| National Floodplain Insurance Program | 1 | 0 | 1 |
| Multi-Hazard Flood Map Modernization Program | 1 | 0 | 1 |
| US Virgin Islands Flood Mitigation Plan | 1 | 1 | 1 |
| Flood Damage Prevention Rules | 1 | 0 | 1 |
| Coastal Zone Management Permitting | 1 | 0 | 1 |
| Areas of Particular Concern | 1 | 0 | 1 |
| Coastal Barrier Protection System | 1 | 1 | 1 |
| Zoning | 1 | 0 | 1 |
| Subdivision Regulations | 1 | 0 | 1 |
| Building Codes | 1 | 1 | 0 |
| **Post-Disaster Hazard Mitigation Plans, Rules and Regulations** | | | |
| Emergency Management Council | 1 | 2 | 0 |
| US Virgin Islands Flood Mitigation Plan | 1 | 1 | 1 |
| Hazard Mitigation Grant Administrative Plan | 0 | 1 | 0 |
| Emergency Operations Plan | 0 | 1 | 0 |
| Hurricane Evacuation Plan(s) | 1 | 0 | 0 |
| **Other Related Programs** | | | |
| Unified Watershed Assessment and Restoration Priorities Program | 1 | 1 | 1 |
| Non-Point Pollution Control Program | 1 | 1 | 1 |
| Sediment Reduction Program | 1 | 1 | 1 |
| Protection of Endangered Species | 1 | 1 | 1 |

**Legend**

0 = No potential relationship
1 = Potential exists to support activity but is not fully realized
2 = Supports activity to full potential of the plan, program or policy

### 3.5.2 SPECIFIC RECOMMENDATIONS

Table 3.6 was included in the 2011 Plan and has been updated, where appropriate. It summarizes the recommendations (organized according to the major categories) that can help continue the process of making hazard mitigation more integrated into the day-to-day operations and long-range planning efforts of the US Virgin Islands government.

**TABLE 3.6 *Recommendations***

| Description | Recommendations for Addressing Issues Identified in Capability Assessment | Implemented in Previous Plan Update Cycle |
|---|---|---|
| **General Plans and Policies**, including:<br>▪ Coastal Zone Management Plan<br>▪ Completion and adoption of Subdivision and Zoning Code Revisions | ✓ Incorporate hazard mitigation directly into existing and proposed general purpose plans in the US Virgin Islands to increase the "profile" of hazard mitigation and ensure incorporation of hazard mitigation in the resulting and related rules and regulations<br>✓ Institutionalize hazard mitigation into Territorial public investments | ✓ Revision of Subdivision and Zoning Code Revisions underway, with help from technical experts |
| **Pre-Disaster Hazard Mitigation Plans, Rules and Regulations**, including:<br>▪ National Floodplain Insurance Program<br>▪ Flood Damage Prevention Rules<br>▪ Coastal Zone Management Permitting<br>▪ Areas of Particular Concern<br>▪ Coastal Barrier Protection System<br>▪ Zoning<br>▪ Subdivision Regulations<br>▪ Building Codes | ✓ Decrease numbers of repetitive loss properties<br>✓ Continue to increase participation in the NFIP<br>✓ Avoid development in hazard prone areas<br>✓ Increase freeboard requirements for development that is approved in flood prone areas<br>✓ Require buildable areas in lots outside of Special Flood Hazard Areas<br>✓ Extend CZM permit requirements to all the islands<br>✓ Require major permit application procedures for subdivision (island wide), i.e., remove Tier 1 and Tier 2 distinctions to the extent possible<br>✓ If tiered system remains, revise Tier 1 boundaries to included regulated natural features such as floodplains, wetlands, salt ponds, mean high tide, and associated buffers.<br>✓ Increase hazard assessment aspects of EAR process<br>✓ Continue APC management planning<br>✓ Assess development suitability in terms of hazard vulnerability as a first step in revising zoning designations to better reflect risk and exposure<br>✓ Strengthen planning and enforcement | ✓ All building inspectors are now required to be certified by ICC, and are required to maintain that certification |

| Description | Recommendations for Addressing Issues Identified in Capability Assessment | Implemented in Previous Plan Update Cycle |
|---|---|---|
| | capabilities through increased staffing and training<br>✓ Strengthen data collection and management capabilities, to create database and sources for use in project development and justification | |
| **Post-Disaster Hazard Mitigation Plans, Rules and Regulations**, including<br>▪ Emergency Management Council<br>▪ Hazard Mitigation Grant Administrative Plan<br>▪ Emergency Operations Plan<br>▪ Hurricane Evacuation Plan(s) | ✓ Improved management of federal grants<br>✓ Increase funding for matching federal grants<br>✓ Integrate hazard mitigation and sustainability considerations into post-disaster recovery process | ✓ HMGP sub-grants have been made available in the aftermath of 3 Presidential declarations in 2010 |
| **Other Related Programs**, including:<br>▪ Unified Watershed Assessment & Restoration Priorities<br>▪ Non-Point Pollution Control Program<br>▪ Sediment Reduction Program<br>▪ Protection of Endangered Species | ✓ Extend watershed approach from related programs to hazard mitigation and development review process. | |

The capability assessment evaluated both the “written word” on mitigation (i.e. the adopted or proposed legislation, regulations, plans and policies in the US Virgin Islands) and the administrative capabilities of US Virgin Islands agencies, departments and authorities.

In summary, many of the necessary policies, regulations and programs are already in place. Likewise, the Government of the Virgin Islands can draw upon the existing expertise in a number of key departments charged with implementing many of the mitigations recommended in this Plan.

To provide support for Hazard mitigation planning the US Virgin Islands Government should try to augment existing resources and agency operating budgets to make a significant impact over the next five years in creating a more sustainable future for the Territory.

This section is organized around the risk assessment process that includes the following eight subsections:

- 4.1 Introduction and Methodology
- 4.2.IFR Requirements for Risk Assessment
- 4.3 Hazard Identification
- 4.4 Hazard Profile
- 4.5 Inventory of Assets
- 4.6 Vulnerability Assessment
- 4.7 Loss Estimates
- 4.8 Loss Estimation Summary and Hazard Ranking

## 4.1 INTRODUCTION & METHODOLOGY

The risk assessment methodology utilized in this Plan Update is the same as was utilized in the 2008 Plan. It is consistent with the process and steps presented in FEMA Publication 386-2, "State and Local Mitigation Planning How-To Guide, Understanding Your Risks—Identifying Hazards and Estimating Losses" (FEMA 2001) and utilizes a risk assessment methodology similar to HAZUS-MH. Figure 4.1 shows the four major steps that comprise the risk assessment process: Hazard Identification, Hazard Profiling, Vulnerability Assessment, and Loss Estimation.

**Step 1 – Hazard Identification**

The hazard identification was compiled by investigating the various natural hazard occurrences within the Territory.

Because it is assumed that hazards that occurred in the US Virgin Islands in the past may be experienced in the future, the hazard identification process for this Plan Update included extensive discussions with VITEMA, its Hazard Mitigation Steering Committee, island Hazard Mitigation Committees and the general public.

Discussions with these groups focused on the identification of hazards for this Plan Update. Information of past hazards was obtained from historical hazard assessment documents, and hazard specific plans and reports developed by experts over the past two decades.

**FIGURE 4.1** ***Risk Assessment Process***

### Step 2 – Hazard Profiling

This step involved determining the extent where possible (i.e. maps), the frequency or probability of future events, their severity, and factors that may affect their severity. Each hazard type has unique characteristics that can impact the Territory in different ways. At the hazard identification phase, several important natural hazards that could affect the US Virgin Islands were considered. The following natural hazards have been documented for the US Virgin Islands and have been assessed as risks for the purpose of this Plan Update. They are listed in the order that they will be discussed in the Plan Update:

- Drought,
- Earthquake,
- Riverine Flooding,
- Coastal Flooding and Erosion,
- Hurricane Winds,
- Rain-Induced Landslide,
- Tsunami, and
- Wildfire

The results of the hazard identification process and discussions reveal that the hazards listed above warrant a vulnerability assessment. It is important to note, however, that the consultant team formally indicated to VITEMA, that there was a concern about the availability of data concerning the mapping (extent) and historic data required to understand the frequency and vulnerability of several of the identified hazards, specifically rain-induced landslide, drought and wildfire.

It is necessary to note that several of these hazards were identified as concerns during the 2011 plan update and mitigation actions were included in the 2011 Plan and 2014 Plan to collect information concerning the location, frequency and history of these events in the Territory. No data has been collected for use in this Plan Update and that data gap will limit the ability to fully profile these hazards – i.e. catalog of events from which to ascertain their frequency of occurrence and/or estimate the magnitude of historical events, let alone to accurately estimate vulnerability and losses (i.e. future impacts).

It is also necessary to note that each hazard model or map that was developed for the 2011 Plan update, with the exception of the Tsunami hazard. The potential impact of climate variability on natural hazards identified in the plan has been discussed qualitatively in the description of the hazards as well as the deficiencies in addressing the impacts of climate change in a more quantitative manner. As such, actions have been added to the Mitigation Strategy (Section 5) of this Plan Update.

**Step 3 – Inventory of Assets**
The inventory of assets quantifies what can be lost when a hazard occurs. Specifically, the people, places, and property that could be injured, damaged, or destroyed are quantified. The following data was collected and calculations were made:

- Estimate or count the total number of buildings, value of buildings, and population in the Territory.
- Determine the proportion of buildings, the value of buildings, and the population in located in hazard prone areas, and
- Calculate the proportion of assets located in hazard areas.

In order to understand that vulnerability of people, buildings and infrastructure to natural hazards, a comprehensive inventory of assets was conducted. Inventory data was classified into a number of asset categories, including population, general building stock, and infrastructure.

Population.
2010 U.S. Census information was updated using projected annual population growth rates for the Territory. A series of calculations were performed to identify the number of people less than 18 years of age and the number of people over 65 years of age. These two demographic subgroups help define the territory's social vulnerability as these two population groups are the most likely to need assistance during and/or after a hazard event.

General Building Stock.
The Virgin Islands Tax Assessors Office (Division of the Office of the Lt. Governor) provided the consultant project team an assessment of the Tax Assessment database in 2014 to assist in the classification of the general building stock. The 2014 database was updated to categorize the built environment into two general occupancy categories: commercial and residential. Detailed below are the procedures used to identify the number of buildings and to estimate the exposure values of the general building stock (replacement and content values).

1. Tax lot or parcel information was aggregated for each estate on each island to identify the number of buildings per occupancy class, per estate. Analysis was limited to commercial and residential type buildings. Data limitations within the tax assessment database precluded the consideration of other occupancy classes, i.e., industrial, government, agricultural, and religious institutions.

2. A matrix was developed to relate the number of building and occupancy classes to specific building types, showing the distribution of model building types throughout each island. Distribution information was compiled to determine the number of building types per specific occupancy class. Collected data was aggregated at the estate level for each island.

3. An average replacement cost was developed for each building type. Replacement costs were based on average construction costs per square foot, reflecting labor and material costs for each island. For each occupancy class, content values were determined as a percent of the replacement

costs (i.e. multiply building replacement costs by content cost percentage to calculate content value).

4. This analysis facilitated a determination of the number of buildings per occupancy class and an aggregate estimate per estate of exposure costs (i.e. replacement value added content value). To enable an island by island comparison, the number of buildings and aggregate replacement and content values of each island were delineated to identify total exposure values for general building stock.

The data utilized in this Plan Update was aggregated from values in the Tax Assessor building stock data and contains estimates of residential and commercial values based on price indexes for housing and construction costs. Annual data sets were derived from publicly available data from the Bureau of Economic Analysis (BEA). The value of structures identified as residential and commercial purposes in this Plan Update are considered to be of "fair market value" for the US Virgin Islands.

Critical Facilities and Infrastructure.
A detailed list of critical facilities and infrastructure was developed by VITEMA with the input from the Hazard Mitigation Steering Committee. The list was based on critical facilities included in the 2011 Plan, the Critical Facility Infrastructure Plan and from information collected from Department of Property and Procurement. Detailed procedures used to update exposure values of critical facilities (replacement and content values) are provided below:

1. VITEMA provided the consultant team with a current listing of critical facilities and infrastructure. It was revealed that the listing was the same as was utilized in the 2011 Plan Update. Therefore, there were not any new critical facilities added to the listing nor were there any site visits undertaken in the 2014 Plan Update. Site visits were not necessary as the general structural characteristics and general conditions of each critical facility identified by VITEMA did not change significantly since the last Plan Update.

2. Facilities/structures were categorized by structural characteristics relevant to the prominent hazards addressed in the vulnerability assessment. The approximate square footage for each facility/structure or group of buildings.

3. Replacement and content values for facilities for the 2011 Plan were provided by the VI Department of Property and Procurement. An evaluation of this data revealed that approximate building areas and construction costs (i.e. exposure) were overstated. Therefore, this Update Plan relied on construction price indices and inflation factors derived from the U.S. Department of Commerce, Bureau of Economic Analysis to update replacement estimates for critical facility classes for this plan update.

The final step of the inventory process is a **vulnerability assessment**, which facilitates an understanding of the proportion of buildings, the value of buildings, and the population that is located in hazard areas. The results of the hazard identification and profile were used to understand characteristics of hazards (i.e. wind

speed, flood depth, etc.) in order to assess the vulnerability parameters (specific damage and loss characteristics) of each asset identified. For instance, a wood frame building will have different damage and loss characteristics for a hurricane than a reinforced concrete structure. A hazard vulnerability assessment level (very low, low, medium, high, and very high) was assigned to each building type or facility to express the vulnerability for the general building stock (model building types) and critical facilities and infrastructure in qualitative terms. It is necessary to note that vulnerability estimates were not conducted for all hazards, especially drought, rain-induced landslides and wildfires. Instead, hazard overlays were performed to identify the number of buildings in hazard susceptibility zones identified on newly created maps for these hazards.

**Step 4—Loss Estimation**

Based on the vulnerability assessment for the general building stock, damage functions were developed to translate the hazard intensity data (given in terms of wind speed, ground shaking, depth of flooding, etc.) into its respective economic loss potential. In its simplest form, a damage function estimates the potential economic damage (e.g., cost to repair/replace the damaged components) of a building or group of buildings to a specified level of hazard intensity. For this study, damage functions were developed based on standard damage ratios obtained from HAZUS^MH for hurricane wind, earthquake and flooding, various published reports, expert opinion and other propriety information. Data limitations did not allow for the development of damage functions or the newly identified hazards: drought, rain-induced landslide and wildfire. The vulnerability assessment only provides a rough estimate of the built environment that is exposed to these hazards and does not allow for a characterization of how a structure or group of structures would perform at a certain level of hazard intensity.

Below are procedures for a prototypical estate in the US Virgin Islands:

1. Hazard maps (location) and hazard profile information (intensity) were used to identify the natural hazard affecting a particular area. Based on the intersection of hazard areas, each estate was assigned a particular hazard intensity level (i.e. hurricane wind speed).

2. Exposure to a specific hazard (i.e. number of buildings, % percentage of total buildings, and value) was determined for identified buildings (general building stock and critical facilities).

3. A qualitative vulnerability level was assigned to each model building type to understand the vulnerability of buildings. This is expressed as a percentage of damage based on a specific hazard level.

4. Qualitative vulnerability levels were related to specific loss estimation tables to determine a specific percentage of damage to a structure (i.e. replacement and content value).

5. To calculate losses, the expected percentage of damage was multiplied by the structure replacement cost and content value.

The loss estimation process provides the US Virgin Islands with a relative ranking of risk to general building stock and critical facilities and infrastructure from various hazards.

Loss estimates associated with drought, wildfire and rain-induced landslides were not analyzed using a risk assessment methodology based on the same principals as described above. Instead, available historical data for each hazard are used and statistical evaluations are performed using manual calculations. The general steps used in this methodology include: compilation of data from national and local sources; verification of data using statistical analysis; determine the frequency of hazard occurrence; and, estimate damages associated with a specific hazard occurrence.

It is important to note that loss estimates in this risk assessment used the best available data and methodologies, but should still be considered approximate. These estimates should be used to understand relative risk from hazards and potential losses and are not intended to be predictive of precise results. Uncertainties are inherent in any loss estimation methodology arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete or outdated inventory, demographic or economic parameter data).

## 4.2 IFR REQUIREMENTS FOR RISK ASSESSMENT

### 4.2.1 IFR Requirements for Hazard Identification and Profiles

§201.4(c)(2) of the IFR states that "[the State plan must include a risk assessment] that provides the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments."

The IFR includes two specific requirements for the identification and profiling of natural hazards:

- **Hazard Identification** per **Requirement §201.4(c)(2)(i): "**[The State risk assessment shall include an] overview of the type … of all natural hazards that can affect the State …."
- **Hazard Profiles** per **Requirement §201.4(c)(2)(i)**: "[The State risk assessment shall include an overview of the] location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate …"

### 4.2.2 IFR Requirements for Vulnerability Assessment and Loss Estimation

The IFR includes two specific requirements regarding vulnerability assessments and loss estimates:

- **Vulnerability Assessment** per **Requirement §201.4(c)(2)(ii): "**[The State risk assessment shall include an] overview and analysis of the State's vulnerability to the

hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State-owned critical or operated facilities located in the identified hazard areas shall also be addressed."

- **Estimated Losses** per **Requirement §201.4(c)(2)(iii): "**[The State risk assessment shall include an] overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure and critical facilities located in the identified hazard areas."

US Virgin Islands local risk assessments were not available. In order to provide risk comparisons among the islands, the Plan Consultant performed, for each island, local risk assessments that meet the IFR **Requirement §201.6(c)(2)** for local mitigation plans. These local risk assessments, while not required by the State IFR guidelines, provide information valuable to the mitigation process.

## 4.3 HAZARD IDENTIFICATION

Since the completion of the 2011 Plan there have not been any new Presidential Disaster Declarations in the US Virgin Islands. As a result, the Territory has not suffered significant loss of property from natural hazards. Since 1995, the US Virgin Islands has received eleven presidential disaster declarations. As shown in Table 4.1, the main sources of damages in recent years have been hurricanes and flooding.

**Table 4.1 Presidential Disaster Declarations in the US Virgin Islands, 1994 – 2010**

| Year | Date | Declaration / Disaster Type |
|---|---|---|
| 2010 | 11/24 | Severe Storms, Flooding, Rockslides, and Mudslides associated with Tropical Storm Tomas |
| 2010 | 11/05 | Severe Storms, Flooding, Mudslides, and Landslides associated with Tropical Storm Otto |
| 2010 | 09/28 | Hurricane Earl |
| 2008 | 1/29 | Hurricane Omar |
| 2004 | 10/07 | Major Disaster / Tropical Storm (Jeanne) |
| 2003 | 12/09 | Major Disaster / Flooding |
| 1999 | 11/23 | Major Disaster / Hurricane (Lenny) |
| 1999 | 11/18 | Emergency / Hurricane (Lenny) |
| 1998 | 09/24 | Major Disaster / Hurricane (Georges) |
| 1996 | 07/10 | Major Disaster / Hurricane (Hortense) |
| 1995 | 09/16 | Major Disaster / Hurricane (Marilyn) |

These hazards have challenged the US Virgin Islands to develop ways to reduce future damages. This subsection describes the process used to identify those hazards addressed in detail in the risk assessment of this Plan Update.

The process included reviewing and identifying a list of natural hazards. The review and evaluation of the hazards included those identified in the 2011 Plan Update. There were not any new additions It is important to note that the Tsunami section in this Plan Update was updated due to new hazard mapping data. The list of hazards addressed in this Plan Update include:

- Drought,
- Earthquake,
- Riverine Flooding,
- Coastal Flooding and Erosion,
- Hurricane Winds,
- Rain-Induced Landslide,
- Tsunami, and
- Wildfire

Each hazard was discussed in detail during the Hazard Mitigation Evaluation Committee and island specific Hazard Mitigation Committee meetings, in addition to summarizing the hazards evaluated and risk assessment process to the general public during public informational workshops. Citizens were given a chance to review this listing and express concerns about hazards on their respective islands.

Citizens on St. John expressed concerns about hurricanes, earthquakes and landslides, while residents on St. Thomas and St. Croix spoke about hurricanes, earthquakes and a greater concern about riverine flooding.

Hazard identification was conducted during a series of steering committee meetings and public informational meetings. The result of this community input and pursuant discussions with VITEMA allow for an evaluation of each of the hazards with criteria that was set forth in the 2014 Plan Update. The evaluation criteria included the following five major benchmarks:

- Ability to describe the hazard,
- Ability to describe the nature of the hazard in USVI,
- Ability to identify the location and map the extent of the hazard,
- Ability to document previous occurrences and frequency of the hazard, and
- Ability to quantify losses for the hazard

The participants at all of the public informational meetings contributed through a lively discussion of both the reasons for inclusion and conversely the reasons for exclusion of hazards that should be addressed in this Plan Update. The decision for the inclusion for the following hazards was made by the Hazard Mitigation Steering Committee. This was indicated to the consultant team that all hazards included in the 2011 Plan are still valid and are of concern to VITEMA.

**TABLE 4.2** ***Hazard Identification Evaluation Matrix, 1994 – 2010***

| Hazard/Criteria[1] | Ability to describe the hazard | Ability to describe the nature of the hazard in USVI | Ability to identify the location and map the extent of the hazard | Ability to document previous occurrences and frequency of the hazard | Ability to quantify losses for the hazard. |
|---|---|---|---|---|---|
| Drought | 3 | 3 | 2 | 1 | 1 |
| Earthquake | 4 | 4 | 4 | 4 | 4 |
| Riverine Flooding | 4 | 4 | 4 | 4 | 4 |
| Coastal Flooding and Erosion | 4 | 4 | 4 | 4 | 4 |
| Hurricane Winds | 4 | 4 | 1 | 4 | 4 |
| Rain-induced Landslide | 3 | 3 | 3 | 1 | 2 |
| Tsunami | 4 | 4 | 4 | 4 | 4 |
| Wildfire | 2 | 2 | 2 | 1 | 1 |

Based on the results, the consensus was to endeavor to undertake an assessment of all of the identified hazards. The Hazard Mitigation Steering Committee and island Hazard Mitigation Committees felt that the several key hazards posed the highest threat to the Territory and demanded attention. These hazards are Hurricane, Earthquake, Flooding and Landslides.

Discussion focused on the fact that there were not sufficient credible and historic data for drought, rain-induced landslides and wildfire hazards to address these hazards in a thorough manner during the last Plan Update. In this regard, the Territory should include specific actions to collect more reliable information for these and other hazards. Actions to collect more reliable information for these and other hazards were included in the 2011 Plan Update. The territory lacks sufficient resource to collect data for specific hazards and such recommendations to collect hazard specific data were removed from this Plan Update.

Nevertheless, VITEMA believes the Territory's position is justified as per key language included in the IFR, specifically the *IFR Requirement §201.4 (c)(2)(ii),* which states: **"***The State shall describe vulnerability in terms of the jurisdictions … **most vulnerable** to damage and loss associated with hazard events."* By identifying the most prevalent hazards, based on the experience of VITEMA, the Territory in effect is pursuing a meaningful evaluation of the *most vulnerable* areas on the three major Islands[2].

[1] Rating:

1 –low ability
2- moderate ability
3 –high ability
4 –very high ability

[2] *The US Virgin Islands Territorial Hazard Mitigation Plan, consistent with the intent of the Disaster Mitigation Act of 2000 (DMA 2000) is focused on natural hazards. The plan does not include consideration of any manmade hazards beyond the secondary effects of natural disasters on sites and facilities with technological, hazard materials or other manmade considerations.*

# 4.4 HAZARD PROFILE

## 4.4.1 HAZARDS AND CLIMATE VARIABILITY

The hazard profiles in this section provide a characterization of each of the hazards, along with a map that delineates the spatial extent of the hazard to identify hazard prone areas within the study area. Each hazard model or map that was developed for the 2011 Plan update has not changed as there was insufficient data to incorporate long-term meteorological data from the selected global climate change models and downscale them for the United States Virgin Islands, specifically for use in the update of hazard maps.

This, however, does not negate the fact that there is a potential impact of climate variability on natural hazards identified in the plan. The impact of climate change has been discussed qualitatively in the description of the hazards in this section of the plan, and deficiencies related to addressing the impacts of climate change in a more quantitative manner have been addressed in the Mitigation Strategy (Section 5) of this Plan Update.

The distinction of natural hazards must be made between those hazards that are potentially affected by climate change and those that are not. In general, all hazards that are of hydro-meteorological origin are potentially affected by climate change, while geo-hazards are generally not influenced by climate variability. The only exception is landslides, which can be caused by intense rainfall events. The figure provides a characterization of hazards identified for this study effort.

| Natural hazard | | | Affected by Climate Change |
|---|---|---|---|
| Geo-hazards | | Earthquake | No |
| Geo-hazards | | Tsunami | No |
| Geo-hazards | Hydro-meteorological hazards | Landslide | Yes |
| | Hydro-meteorological hazards | Flood | Yes |
| | Hydro-meteorological hazards | Coastal Flooding | Yes |
| | Hydro-meteorological hazards | Drought | Yes |
| | Hydro-meteorological hazards | Hurricane | Yes |
| | Hydro-meteorological hazards | Wildfire | Yes |

*Source: Revised from Schmidt-Thomé 2005*

It is necessary to note that projections simulated by global climate models are often simulated at space scales too coarse for direct use in impact studies at regional scale or smaller. Several organizations have

employed techniques to derive the 21st century temperature and rainfall scenarios for the Caribbean from projections simulated by various global climate models, but there are to-date no models that are specific for use in the US Virgin Islands.

While acknowledging the above data and associated limitations, a set of reference projection ranges are used to allow for an understanding of the potential impacts of climate change in the Territory, which are summarized in the table below:

| Hazard | Location | Climate Change Projected Impact | Potential Future Change in Hazard |
|---|---|---|---|
| Earthquake | St. Thomas, St. John, St. Croix | N/A | N/A |
| Tsunami | St. Thomas, St. John, St. Croix | N/A | N/A |
| Landslide | St. Thomas, St. John | Expected increase in intense precipitation events. | + |
| Flood | St. Thomas, St. John, St. Croix | Expected increase in intense precipitation events. | + |
| Coastal Flooding | St. Thomas, St. John, St. Croix | Projected rise in sea level will augment surge and wave heights to increase projected costal flood depths and extents. | + |
| Drought | St. Croix | Expected reduction in average rainfall which impact of drought; Average temperature increases reduce the water availability for drought and wildfire hazards. | + |
| Hurricane | St. Thomas, St. John, St. Croix | Percent increases in wind speed may be applied over the hurricane hazard to derive projected hurricane wind speeds taking into consideration variability | – |
| Wildfire | St. Croix | Expected reduction in average rainfall which impact of wildfire; Average temperature increases reduce the water availability for drought and wildfire hazards. | + |
| Legend: + increase in hazard intensity due to climate change; – decrease in hazard intensity due to climate change | | | |

## 4.4.2 DROUGHT

### Hazard Description

Drought is a normal part of virtually all climatic regimes, including areas with high or low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length.

Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Table 4.3 below presents definitions for these types of droughts.

**TABLE 4.3** ***Drought Classification Definitions***

| Term | Definition |
|---|---|
| **Meteorological Drought** | The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales. |
| **Hydrologic Drought** | The effects of precipitation shortfalls on stream flow and reservoir, lake, and groundwater levels. |
| **Agricultural Drought** | Soil moisture deficiencies relative to water demands of plant life, usually cropland but can also include rangeland. |
| **Socioeconomic Drought** | The effect of demand for water exceeding supply as a result of a weather-related supply shortfall. |
| Source: *Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy*, FEMA | |

### Nature of the Hazard

In the U.S. Virgin Islands, adequate water supplies are critical for the wellbeing and economic security of the islands. Water resources or access to them are already limited and subject to competing demands (i.e. growing population and a growing tourist industry). The US Virgin Islands has extremely limited surface-water resources and limited ground-water resources, receives only moderate rainfall, much of which is lost to evaporation and surface run-off.

Therefore, droughts can exacerbate the problem of ensuring a sustainable yield of potable water. With no year-round streams and only limited ground water resources, 65% of drinking water supplies are provided by desalination (removing the salt from seawater). Groundwater provides 22% of the drinking water supply and the remaining 13% is from rooftop catchments.

Because the US Virgin Islands never has enough freshwater and a majority of the drinking water supplies are provided by desalination, it is already the most expensive publicly supplied water in the United States.

Any reductions in the amount or type of precipitation will only increase those costs. http://www.usgcrp.gov/usgcrp/nacc/education/islands/islands-edu-3.htm

Droughts also increase the potential for wildfires, adversely affect farming, and can cause strains on already strained water resources throughout the territory.

## Hazard Location, Extent and Distribution

Figure 4.2, 4.3, and 4.4 illustrate the geographic coverage of drought on all three islands. The entire Territory is susceptible to the effects of drought. There are, however, some useful distinctions between islands which should be noted:

- **St. Croix** – drought can have an impact in southern coastal areas on St. Croix, where historically large sections of land were allocated to agriculture, primarily dairy and livestock. Impacts included reduced productivity of rangeland and reduced milk production. Small scale agriculture can also be impacted. Production costs can increase owing to the cost of water supply, transport and/or transfer.
- **St. John** – Coral Bay is at risk to drought as precipitation shortfalls can impact small scale agriculture and impact residential developments because of increased costs for water supply, transport and/or transfer.
- **St. Thomas** – In terms of specific locations, the East End of the island is the most susceptible to the impact of droughts. Although, urban areas of Charlotte Amalie are not immune to drought due to increased costs for water supply and transfer.

## Disaster History

The recorded history of droughts is very limited for the US Virgin Islands. There are scant references to droughts in historical reports. For instance, in 1733, when the islands were administered by the Danish, the islands were severely affected by drought, suffered an insect plague, and were affected by two hurricanes.

In the 1920's to 30's, St. Croix experienced a period of drought. During this time the U.S. Government assisted with the construction of Creque Dam (1923) to capture rain water. This program was expanded throughout the islands. Several reservoirs and catchment areas were constructed near the towns to collect rain water. Ponds were created for maintenance of livestock. Windmills were converted to cisterns and wells were sunk in former cane fields to fill water troughs.

The first Federal declaration in US Virgin Islands for drought was in June 8, 1964. Although the effects of this event are were not reported, it is listed on FEMA's website as an extreme event.

In recent years, droughts have been more frequent and severe. Minor shortfalls in rainfall have dramatically affected agriculture and have required water rationing. In 2002, the Virgin Islands Daily News reported that

East End of St. Croix was suffering a localized severe drought. According to local farmers this drought compares to the drought of the early 1970s. This event predicated the need for organized feeding programs and consequently had a major impact to cattle farmers. The National Weather Service reported that accumulated rainfall for St. Croix through 2002 was deficient. During the last seven months of that year, approximately 55 percent of normal rainfall was received.

According to the National Climate Data Center, there have been no new drought events reported in the Territory since 2002.

**FIGURE 4.2** ***Drought Hazard Map, St. Thomas***

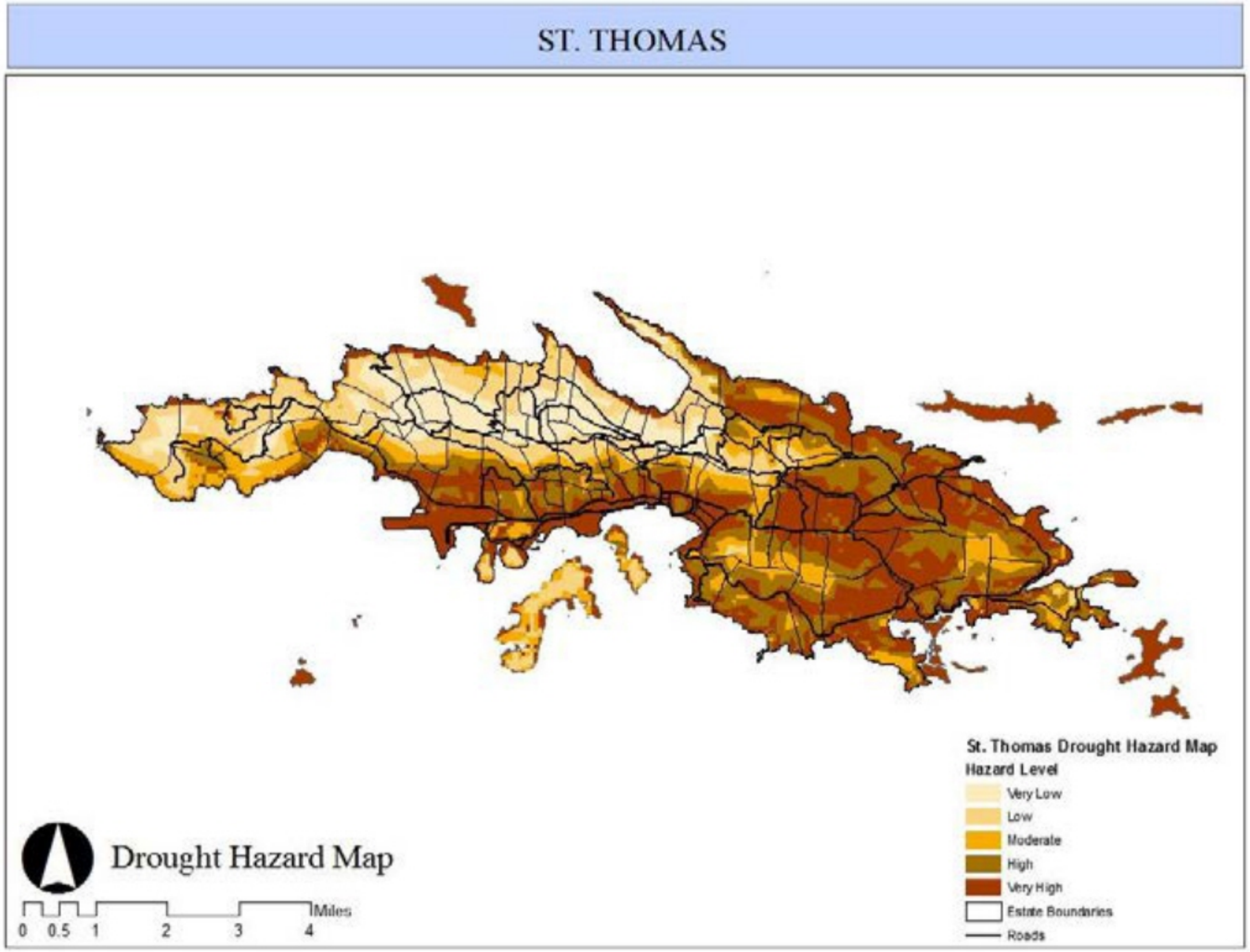


**FIGURE 4.3** ***Drought Hazard Map, St. Croix***

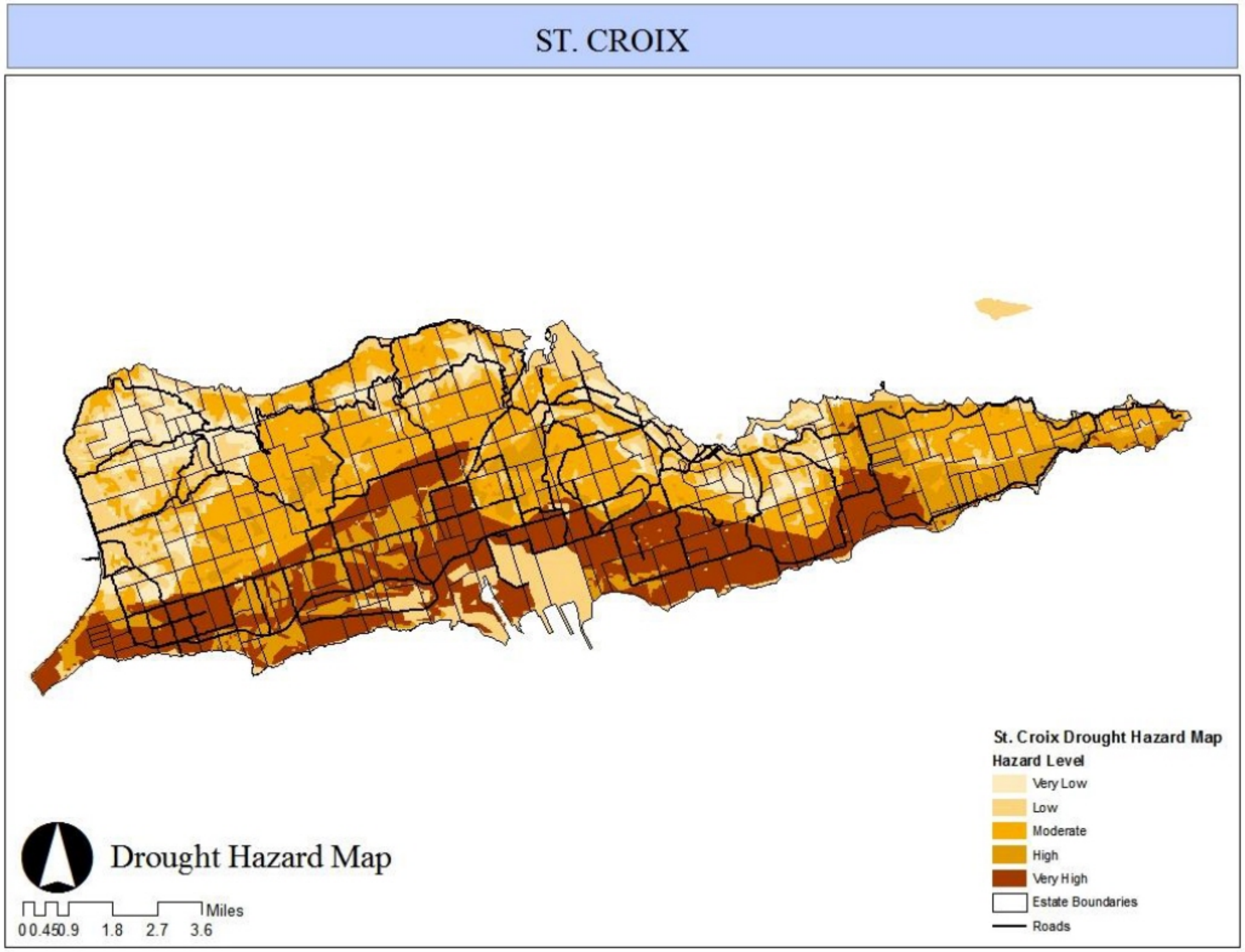
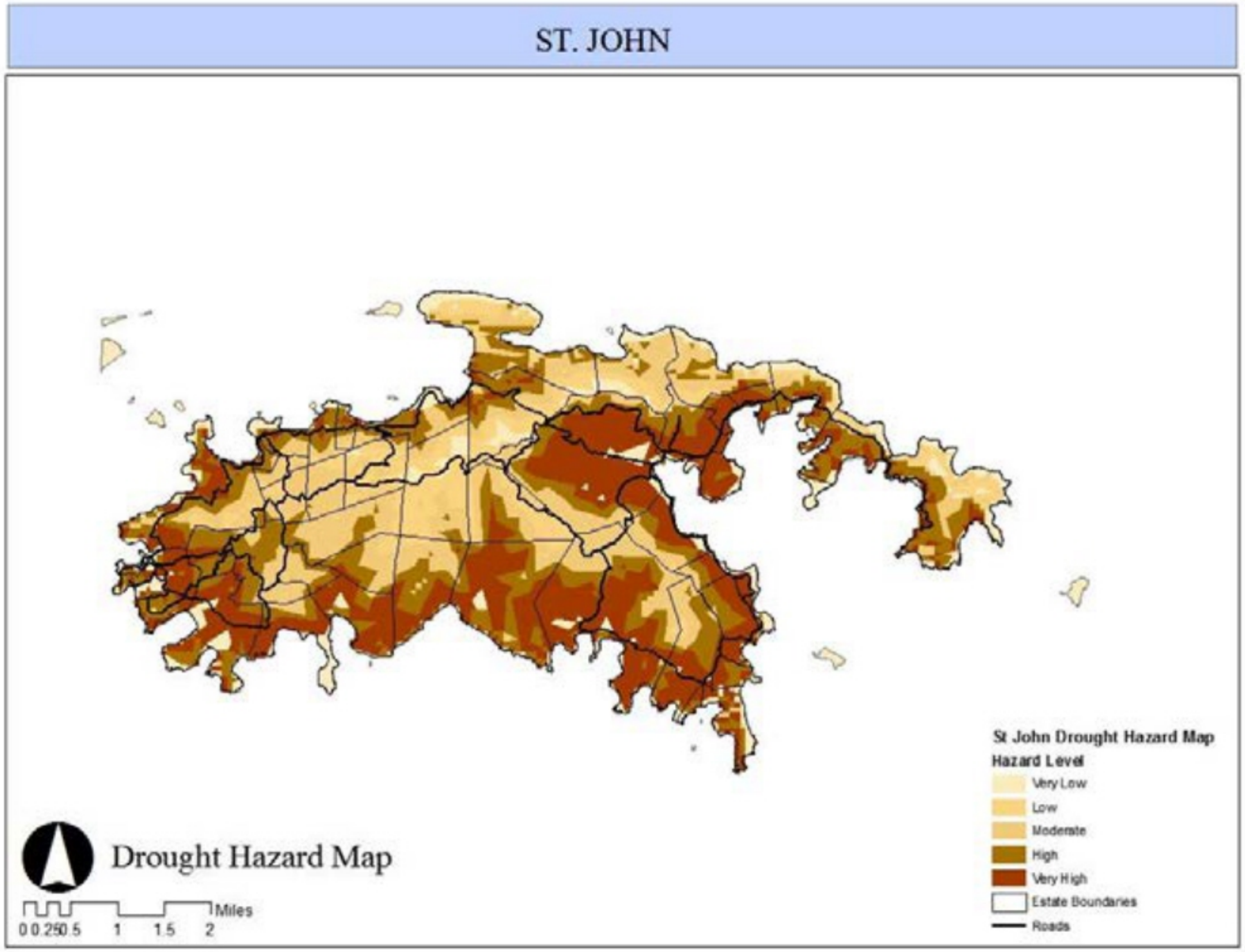


**FIGURE 4.4** ***Drought Hazard Map, St. John***



## Climate Variability, Hazard Frequency and Magnitude

There is a general lack of understanding on the definition, on-set, and frequency of drought in the U.S. Virgin Islands.

However, based on regional information gathered from the Caribbean Institute for Meteorology and Hydrology and the Brace Centre for Water Resources Management, McGill University, the frequency of drought hazards in the Caribbean will increase due to climate variability.

Taking into consideration climate change data, the McGill University furthers that climate change models indicate that temperatures are very likely to rise (90-99% probability) and that there is expected to be a decrease in annual precipitation in the region of 5 to 15% with the greatest change during the months of June to August.

Such data provides a clear indication that the occurrence of drought events will increase in the future, which in turn means that there is likely to be a decrease in reported incidence of periods defined as having no drought.

Therefore, drought probability, which is tied to annual average precipitation, for Caribbean region which includes the US Virgin Islands is estimated to be 40% below normal[3].

## Data Sources, Models and Methodologies

**Base Data**

- (2010): Average Annual Rainfall 1971 -2000, Oregon State University (OSU) Spatial Climate Analysis Service.
- USACE Digital Terrain Model (2008)
- Hydrologic Units for USVI (2002) U.S. Geological Survey in cooperation with the U.S. Department of Agriculture, Natural Resources Conservation Service.
- The United States, Caribbean and Pacific Basin Major Land Resource Areas (MLRA) Geographic Database serves as the geospatial expression of the map products presented and described in Agricultural Handbook 296 (2006).

**Drought Hazard Assessment and Determination**

- (2009): The Caribbean Drought and Precipitation Monitoring Network: The Concept and its Progress http://www.wamis.org/agm/meetings/wies09/S3B-Trotman.pdf

[3] Drought and Precipitation Monitoring for Enhanced Integrated Water Resources Management in the Caribbean (2008)

- (2010): Drought Impacts and Early Warning in the Caribbean: The Drought of 2009-2010; Adrian R. Trotman David A. Farrell; http://www.wmo.int/pages/prog/drr/events/Barbados/Pres/4-CIMH-Drought.pdf
- UN/ISDR, 2007. Drought Risk Reduction Framework and Practices: Contributing to the Implementation of the Hyogo Framework for Action. United Nations Secretariat of the International Strategy for Disaster Reduction (UN/ISDR), Geneva, Switzerland, 98+vi pp.
- US National Assessment of the Potential Consequences of Climate Variability and Change Educational Resources Regional Paper: US-Affiliated Islands of the Pacific and Caribbean, http://www.usgcrp.gov/usgcrp/nacc/education/islands/islands-edu-3.htm


**Inventory Data (Assets)**

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

### 4.4.3 EARTHQUAKE

## Hazard Description

An earthquake is a sudden motion or trembling of the earth caused by an abrupt release of stored energy in the rocks beneath the earth's surface. The rocks that make up the earth's crust are very brittle. When stresses due to underground tectonic forces exceed the strength of the rocks, they will abruptly break apart or shift along existing faults. The energy released from this process results in vibrations known as seismic waves that are responsible for the trembling and shaking of the ground during an earthquake. Earthquakes are also caused by tremendous rock slides that occur along the ocean floor.

There are several different ways to express the severity of an earthquake. The two most common are: *magnitude*, which is the measure of the *amplitude* of the seismic wave and is expressed by the Richter scale, and *intensity*, which is a measure of how strong the shock was felt at a particular location, expressed by the Modified Mercalli Intensity (MMI) scale. The Richter scale represents a logarithmic measurement where an increase in the scale by one whole number represents a tenfold increase in measured amplitude of the earthquake. Table 4.4 shows the rough correlation between the Richter scale, Peak Ground Acceleration (PGA), and MMI. The relationship between PGA, magnitude, and intensity are, at best, approximate, and also depend upon such specifics as the distance from the epicenter and depth of the epicenter.

| **TABLE 4.4** ***Earthquake Magnitude / Intensity Comparison*** | | | |
|---|---|---|---|
| **PGA ( in %g)** | **Magnitude (Richter)** | **Intensity (MMI)** | **Description (MMI)** |
| <0.17 | 1.0 - 3.0 | I | I. Not felt except by a very few under especially favorable conditions. |
| 0.17 - 1.4 | 3.0 - 3.9 | II - III | II. Felt only by a few persons at rest, especially on upper floors of buildings.<br><br>III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated. |
| 1.4 – 9.2 | 4.0 - 4.9 | IV - V | IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rock noticeably.<br><br>V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop. |
| 9.2 - 34 | 5.0 - 5.9 | VI - VII | VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.<br><br>VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. |
| 34 - 124 | 6.0 - 6.9 | VIII - IX | VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.<br><br>IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |
| >124 | 7.0 and higher | VIII or higher | X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.<br><br>XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.<br><br>XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air. |
| Source: Wald, D., et al., “Relationship between Peak Ground Acceleration, Peak Ground Motion, and Modified Mercalli Intensity in California.” | | | |

## Nature of the Hazard

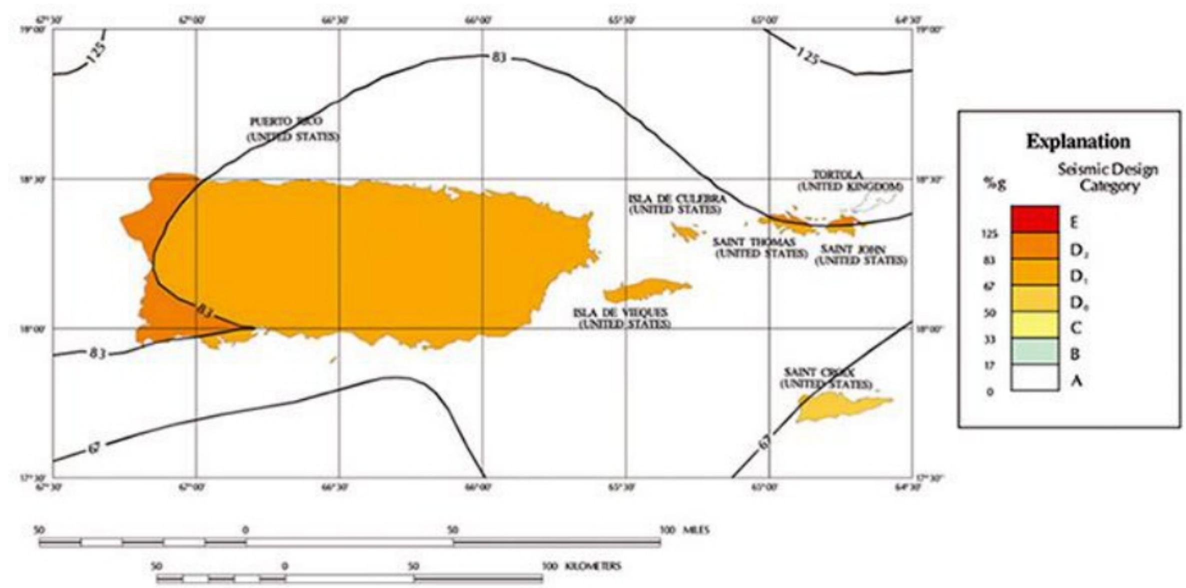
The US Virgin Islands are located on the northeastern edge of the Caribbean Plate. Although there has been what is referred to as a “seismic gap” where no significant events have been recorded for a long period, the area is still considered very seismically active. The US Virgin Islands is actually considered as earthquake prone as many areas of California. However, the difference of these two areas is that the plate that affects the Virgin Islands is deep compared to the rather shallow fault line in California producing less harmful seismic events.

It also appears from research that the rate of attenuation for earthquakes in this region is lower, i.e., earthquake shocks propagate longer and farther in this region given the same initial earthquake intensity, than earthquakes that occur in the northeastern United States (IRF 1984).

The exact configuration of the Caribbean Plate boundary in the vicinity of the Virgin Islands is poorly understood and is also quite complex. The Island of Puerto Rico and all the northern Virgin Islands are considered a “microplate” caught within the plate boundary. Zones of continuing deformation surrounding this microplate pass through the Anegada Passage separating the northern Virgin Islands from St. Croix, as well as along the eastward continuation of the Puerto Rico Trench to the north (EQE International 1994). These two features comprise the principal source of earthquakes that affect the US Virgin Islands.

Generalized seismic maps were developed by USGS to provide guidance for construction in 2010. Figure 4.5 below provides a depiction of the hazard intensity so as to provide guidance to building design and construction professionals. The seismic design categories for Puerto Rico and the Virgin Islands have been developed for low rise occupancy Category I and II structures located on sites with average alluvial soil conditions.

***FIGURE 4.5*: Seismic Design Map for Puerto Rico and the Virgin Islands**




source: http://www.fema.gov/earthquake/earthquake-hazard-maps

The colors in the maps denote "seismic design categories" (SDCs), which reflect the likelihood of experiencing earthquake shaking of various intensities. (Building design and construction professionals use SDCs specified in building codes to determine the level of seismic resistance required for new buildings.) The following table describes the hazard level associated with each SDC, and the associated levels of shaking. Although stronger shaking is possible in each SDC, it is less probable than the shaking described.

**TABLE 4.5: Seismic Design Categories**

| SDC | Map Color | Earthquake Hazard | Potential Effects Of Shaking* |
|---|---|---|---|
| A | White | Very small probability of experiencing damaging earthquake effects. | |
| B | Gray | Could experience shaking of moderate intensity. | Moderate shaking—Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. |
| C | Yellow | Could experience strong shaking. | Strong shaking—Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built structures. |
| D0 | Light brown | Could experience very strong shaking (the darker the color, the stronger the shaking). | Very strong shaking—Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. |
| D1 | Darker brown | | |
| D2 | Darkest brown | | |
| E | Red | Near major active faults capable of producing the most intense shaking. | Strongest shaking—Damage considerable in specially designed structures; frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Shaking intense enough to completely destroy buildings. |
| * Abbreviated descriptions from The Modified Mercalli Intensity Scale.; source: http://www.fema.gov/earthquake/earthquake-hazard-maps | | | |

The Puerto Rico Trench runs E-W about 100 km to the north of Puerto Rico and the northern Virgin Islands. The deepest section of the trench, approximately 8 km, is located to the north of Puerto Rico. The Anegada Passage fault zone extends for approximately 375 km north-east and comprises a series of interconnected basins up to 4.4 km deep. This deep trench separates St. Croix from the Puerto Rico – Virgin Islands platform (EQE International 1994).

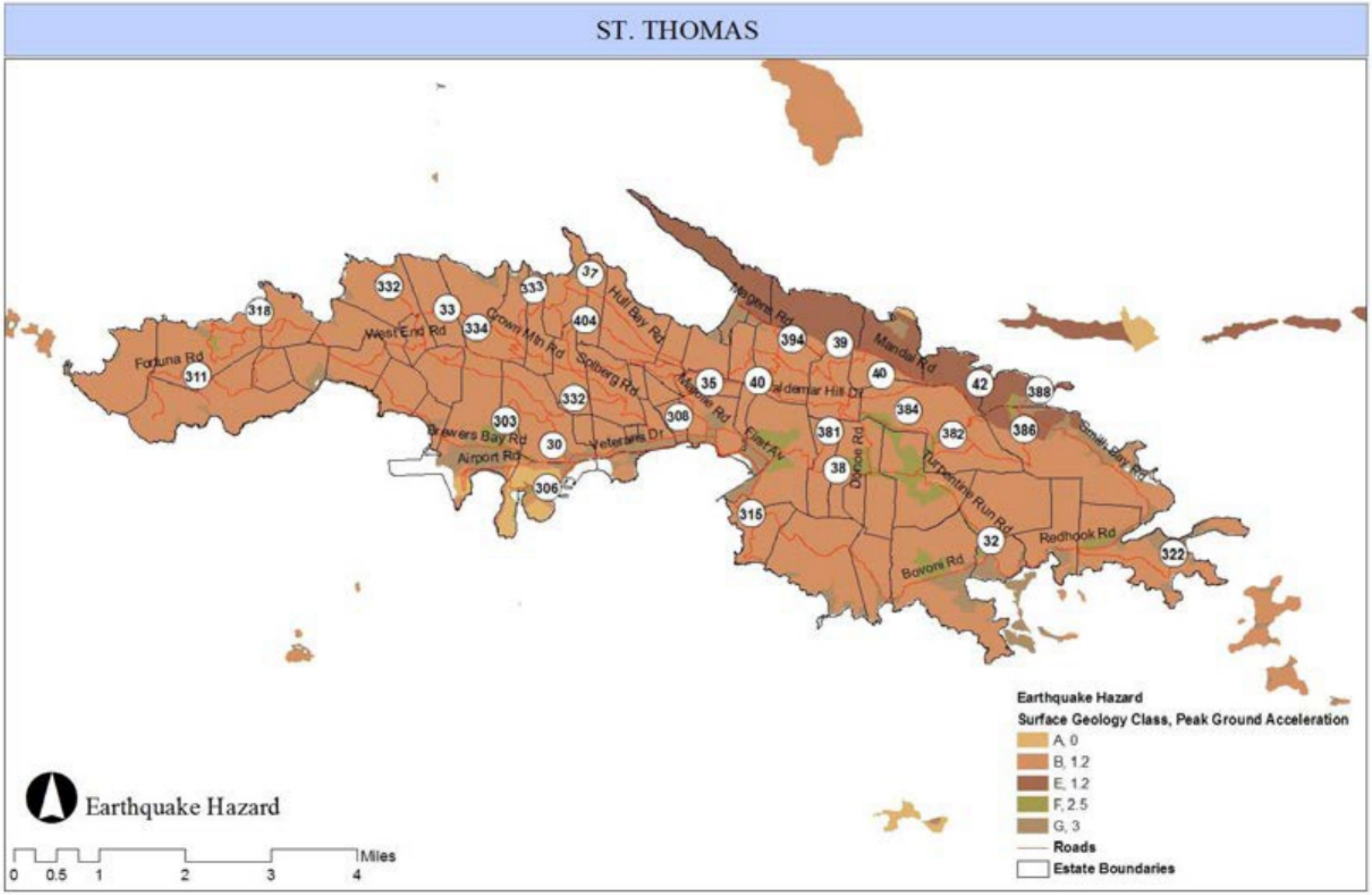
## Hazard Location, Extent and Distribution

The extent of the earthquake risk is not uniform territory wide. Figure 4.8 illustrates the geographic coverage of earthquake hazard prone areas on the three major islands.

St. Thomas and St. John have been formed as a result of underwater volcanic flows and can be considered to have very similar geology. Both islands have a thin soil cover of sedimentary deposits, limestone, alluvium and recent beach deposits. The Cretaceous-aged Louisehoj and Water Island formations are highly weathered, jointed and fractured (Geoscience Associates 1984). From a geologic stand point the islands are essentially the same land mass, separated by a garden, Pillsbury Sound. .

As illustrated in the maps (Figure 4.6, 4.7 and 4.8), the hazard intensity varies throughout St. Thomas and St. John. On both islands, hillsides are susceptible to earthquake induced land sliding. Geoscience Associates (1984) point to several causes that have increased susceptibility on these islands. They include: increased hillside development; removal of slope vegetation; and steeper man-made slopes. Other critical areas include the waterfront area of Charlotte Amalie that is built upon alluvial soils and various land fill. The performance of such materials is notoriously poor.

**FIGURE 4.6** ***Earthquake Hazard Map, St. Thomas***








DHS-FEMA-18-0266-C, DHS-FEMA-18-0267-C, DHS-FEMA-18-0268-C.pdf-001146

002578

**FIGURE 4.7** ***Earthquake Hazard Map, St. Croix***

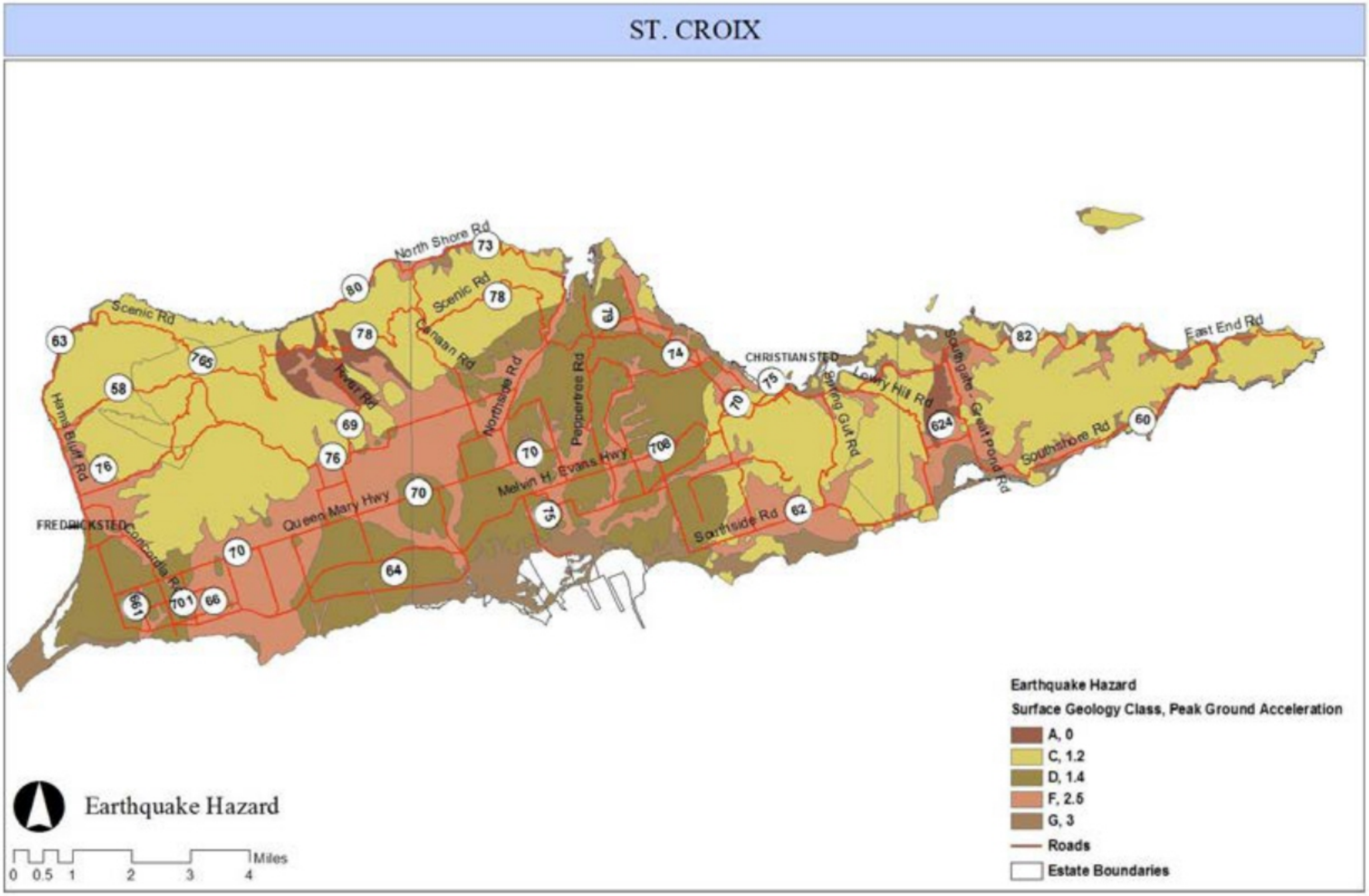
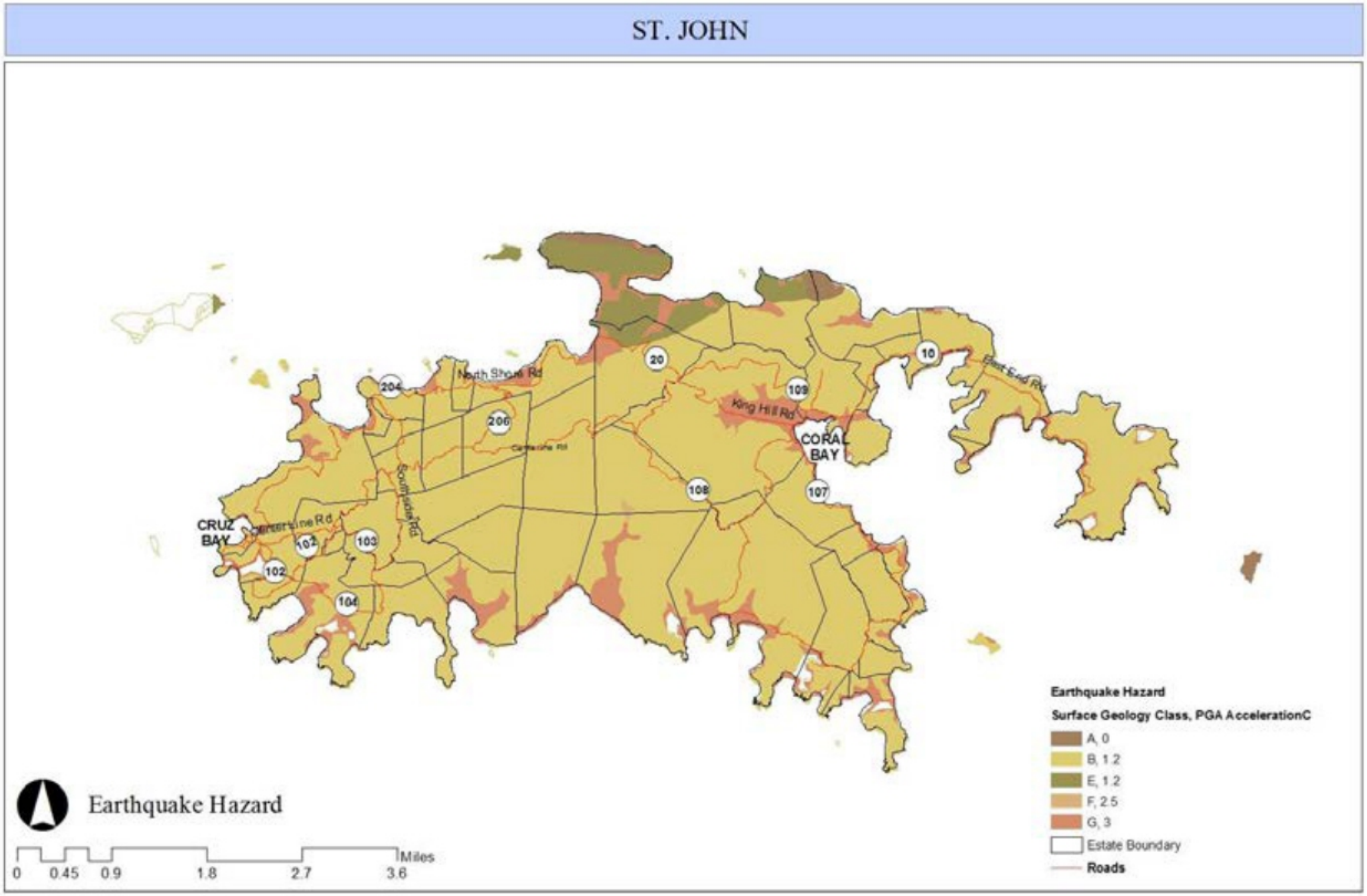


**FIGURE 4.8** ***Earthquake Hazard Map, St. John***



St. Croix is not volcanic in origin. Its soils and rock formations have developed from sedimentary processes. The major rock types of St. Croix are siltstones, limestone, sandstones, conglomerates, marls, volcanic ashes, and minor granite intrusives. The rock formations are tilted up to near vertical orientation. The rock formations include Caledonia, Allandale, Cane Valley, and Judith Fancy formations, all of late Cretaceous age (Geoscience Associates 1984).

Much of Christainsted and Frederiksted waterfronts mimic the performance of the waterfront areas on St. Thomas. Much of the town of Frederiksted is supported on residual soils of the Kingshill Marl Formation, the most granular faces of which appeared to be liquefaction prone (Geoscience Associates 1984). Christiansted is built upon alluvial soils and various land fill also making it prone to liquefaction. On St. Croix, there are widespread structural concerns throughout the island. The 1984 Geoscience Associates report points out that hillside construction on St. Croix, especially houses supported on stilts, are quite susceptible to earthquakes.

## Disaster History

There is a verifiable record of earthquake occurrences dating back more than 500 years. More than 200 "felt events" have been recorded in the area since the first reliable report on September 1, 1530 near the coast of Venezuela. The first recorded incident directly affecting what is now the US Virgin Islands was in 1777, when a shock with an estimated intensity on the Modified Mercalli scale of IV-V was reported on St. Thomas (see Table 4.4). Over the next two hundred years, as many as 170 individual events were recorded (IRF, 1984) but none have been of great consequence since 1867 when an earthquake estimated at MMI VIII on St. Thomas and VII-VIII on St. Croix as recorded. Since that time there have been no major events with the highest estimated intensity measured at MMI IV-V. Due to the moderate nature of these events and their non-destructive nature there has been no Federal disaster declaration for any of these occurrences

It is worth noting; however, that the Puerto Rico Seismic Network, for its area of responsibility (latitude 17.00 -20.00˚ N and longitude -63.50 -69.00˚), and for the period from April 2011 to April 2014 there have been 65 seismic events with a magnitude of 4.0 or greater on the Richter Scale. The strongest of these was an event that had a magnitude of 6.4 on the Richter Scale and occurred in the Puerto Rico on January 13, 2013.

Clearly the event that stands in our minds is the event in Haiti on January 2010. The 2010 Haiti earthquake was a catastrophic magnitude 7.0 Mw earthquake, with an epicenter near the town of Léogâne, approximately 25 km (16 miles) west of Port-au-Prince, Haiti's capital. An estimated three million people were affected by the quake; the Haitian government reported that an estimated 316,000 people had died, 300,000 had been injured and 1,000,000 made homeless.[4]

The region from Puerto Rico to the Virgin Islands is seismically active. In 2010, the majority of earthquakes occurred along the Puerto Rican Trench. This is worth noting, as in 2009, most earthquakes had epicenters massed to the north of the Virgin Islands. Earthquakes (above 4.0) averaged nineteen (19) per year.

4 a b "Red Cross: 3M Haitians Affected by Quake". CBS News. 13 January 2010. Retrieved 13 January 2010.
^ "Haiti raises earthquake toll to 230,000". AP. The Washington Post. 10 February 2010. Retrieved 30 April 2010.
^ "Haiti will not die, President Rene Preval insists". BBC News. 12 February 2010. Retrieved 12 February 2010.

## Hazard Frequency and Magnitude

It has been estimated that an earthquake with the same magnitude as the 1867 earthquake event would have a 300 to 5,000 year recurrence interval (RI). For practical purposes, this is a longer RI than is useful for planning and design purposes. However, there are two useful references for assessing the probability of an earthquake of destructive proportions in the US Virgin Islands, the first of which uses the same value as the 1867 event.

The first is the "design earthquake" recommended by the Natural Hazards Planning Council. The Council selected a "design earthquake"[5] of level MMI VIII for use by engineers and planners to prevent damage from events that they believed have a reasonable expectation of occurring in the US Virgin Islands (IRF, 1984) given the region's general seismicity. The second reference is from a study prepared for the US Virgin Islands Water and Power Authority (WAPA, 1994). In this study, the authors determine that the earthquake intensity likely to have a recurrence interval on the scale of 100 years is in the MMI VI-VII range. Based on this estimate (100-yr), the US Virgin Islands has a 1/100 or a 1% annual probability of an event in the MMI VI-VII range.

The Seismic Hazard Map of 1994 (Earth Science Consultants, 1999), which provides ground shaking intensity (expressed in terms of Peak Ground Acceleration (PGA) for 50-, 100-, 250-, and, 1,000-year return periods). This study, utilized the 1000-year ground shaking map. This map was generated using an acceleration variability ($\sigma$) of 0.6 at a set of sites across each island. The Peak Ground Acceleration (PGA-%g) ranges from .48 to .91g for a 1000-year return period. Based on this return period (1000-yr), the US Virgin Islands has a 0.1% percent annual probability of observing the losses shown in this risk assessment.

## Data Sources, Models and Methodologies

Information for the development of the Earthquake Risk Assessment came from a variety of sources, including:

**Base Data (Earthquake)**

5 design earthquake event is used for estimating the demands and predicting the supplies of the real three-dimensional soil-foundation-building system performance during an event.

- 1000-year probabilistic ground shaking intensity maps (Earth Scientific Consultants 1999).
- Earthquake vulnerability maps, which classified acceleration factors for local site geology, using NEHRP[6] provisions to define localized site amplification classification (Earth Scientific Consultants, 1999)
- Charles Mueller, Arthur Frankel, Mark Petersen, and Edgar Leyendecker (2010) New Seismic Hazard Maps for Puerto Rico and the U.S. Virgin Islands. Earthquake Spectra: February 2010, Vol. 26, No. 1, pp. 169-185.

**Earthquake Hazard Assessment and Determination**

- The hazard assessment was developed using the Seismic Hazard Map of 1994 (Earth Science Consultants, 1999), which provides ground shaking intensity (expressed in terms of Peak Ground Acceleration (PGA) for 50-, 100-, 250-, and, 1,000-year return periods)
- The 1000-year ground shaking map was generated using an acceleration variability ($\sigma$) of 0.6 at a set of sites across each island. Acceleration factors were identified based on local soil conditions and the surficial geology.
- Local site geology was classified using NEHRP provisions to define localized site amplification classification.
- GIS overlay techniques were used to assign an earthquake susceptibility factor (PGA) to. each estate.

**Inventory Data (Assets)**

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

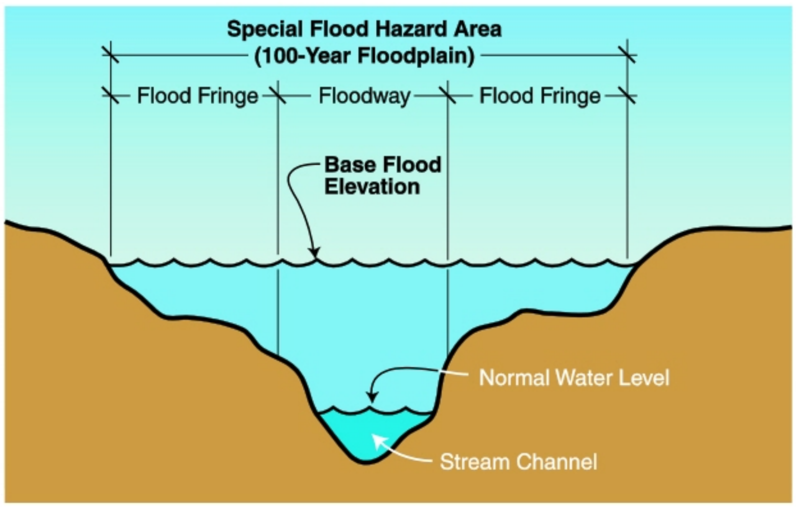
[6] NEHRP is the National Earthquake Hazards Reduction Program. This program's congressional mandate is "to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program".

## 4.4.4 RIVERINE FLOODING

### Hazard Description

Floods are naturally occurring events for rivers and streams. Excess water from rainfall accumulates and overflows onto banks and adjacent floodplains — lowlands adjacent to guts, streams, or rivers that are subject to recurring floods (see Figure 4.9 below).

**Figure 4.9** ***Definition Sketch for Floodplains***




Source: *Understanding Your Risks* – FEMA Publication 386-2, Page 2-12

FEMA's National Flood Insurance Program (NFIP) maps many floodplain boundaries. The *Digital Flood Insurance Rate Maps (DFIRMs)* have been updated and reissued in April 2007. They have been provided to the Territory. These maps provide the Territory with a more useful resource for planning and site specific decision making related to flood hazards. The *2007 US Virgin Islands Digital Flood Insurance Rate Maps (DFIRMs)* are used as reference for the National Flood Insurance Program. The Flood Insurance Study; however, provides more detailed information in certain areas where Base Flood Elevations (BFEs) and/or floodways have been determined.

Historically, floods often exceed the mapped floodplains in the Virgin Islands. The 2007 Flood Insurance Study for the US Virgin Islands indicates that the principle causes of flooding are associated with storm water run-off. In addition, flooding is caused by encroached upon artificial fills and structures (e.g., filling in floodplain or floodway areas, or increased imperviousness within the watershed from new development) and where guts in many areas are filled with debris (e.g., accretion, erosion, sedimentation, etc.).

## Nature of the Hazard

Heavy floods are a common feature of Caribbean islands. This is due to tropical weather patterns that are exacerbated during hurricane season from June to November and to higher seasonal rainfall in the fall months of August, September, October and November. There have been a number of large-scale devastating flooding events through time. Historically, most of these large-scale events have had the greatest impact outside of the island's urban areas. Inland flooding from more frequent, but smaller storm events, has caused more cumulative damage over the long run in the more urbanized areas in the US Virgin Islands, although it is less damaging on an event-by-event basis.

The islands' mostly hilly to rugged and mountainous terrain, especially on St. Thomas and St. John, is coupled with thin soils and non-porous rock substrata. The steep drainage ditches or "guts" that receive most of the runoff create optimal conditions for over-bank flooding problems. Added to this natural tendency to generate flooding conditions are the following:

- Increases in impervious surfaces in the urbanizing areas of the islands as seen in Frenchtown Area in St. Thomas; Sub base Area in St. Thomas; Christiansted Area in St. Croix; Cruz and Coral Bay on St. John
- The placement of undersized culverts where roads cross guts as witnessed in Dorethea in St. Thomas or Gallows Bay in St. Croix;
- A failure to upgrade storm water management facilities to meet the needs of on-going development (i.e. Enighed Pond St. John),
- Lack of consistent maintenance of other storm water management facilities (i.e. Radets Gade St. Thomas, Garden Street on St. Thomas); and
- Encroachments to the floodplain built over many years (i.e. La Grande Princess in St. Croix).

As highlighted above, frequent inundation of property persists. Many of these problems are highlighted in the Mitigation Strategy and Severe Repetitive Loss Strategy of this Plan Update.

## Hazard Location, Extent and Distribution

Figure 4.10, 4.11, and 4.12 illustrate the geographic coverage of riverine flooding on the three major islands. The extent and geographic distribution of the regulated 100-year floodplains differ amongst the three islands due to their geology, topography, soils, and rainfall distribution patterns.

The island of St. John overall topographic profile is lower than nearby St. Thomas. However, the average annual rainfall is the greatest of the three major islands of the Territory with 54" compared to 44" on St. Thomas and 40" on St. Croix. The steep terrain of St. John concentrates runoff in natural guts that transverse to the sea. Flooding, like all hazards, is not a problem unless development or infrastructure alters the landscape. This is because the majority of the island is a National Park and remains in its natural state. Coral Bay and the surrounding area have experienced rapid development without regard for effective storm water drainage systems both in the highland areas and lowland environs. The former disregard intensifies the problems of the latter.

Most of the flooding occurs in Cruz bay or Coral Bay. These areas are prone to flooding as they are both located at the bottom of steep hills. Problems are caused by development without regard for sufficient drainage and inadequate drainage systems or improper engineering for the critical roadways. Although these manifestations cause localized flooding the problem is severe enough to disrupt commerce and emergency access. Particular areas of concern identified by citizens include: Poor or inadequate storm water drainage infrastructure on Centerline and Bordeaux Mt. Roads; need to improve storm water drainage infrastructure to alleviate localized flooding at the Guy Benjamin School in Coral Bay; water drainage system at Guinea (Westin) Gut and localized flooding at Enighed Pond (i.e. WAPA building and treatment plant and areas of Route 102 and Route 104 by the Tennis Court).

St. Thomas, like St. John, is volcanic island, with steep terrain and significant topographical relief. The island is rather heavily developed with two major urban areas, an extensive road network and the accompanying infrastructure. The areas with the most serious flooding problems are in Estate Nadir. This is essentially a continuous drainage system with the drainage channel in Estate Nadir connecting with the natural gut (Turpentine Gut). In the event of heavy rains the Gut and man-made channels have proved to be inadequate to handle the water runoff from the surrounding hillside.

Flooding persists on the East End of the island, particularly in Red Hook, where intensive commercial development has put pressure on drainage infrastructure. The inadequate storm water drainage system in Frydenhoj (next to and across from ball field) has caused localized flooding to commercial and residential structures. The development of many residences in the East End area has either altered the natural flow of runoff or increased the impervious surface area through the construction of the residences and the attending access roads and driveways.

This is witnessed on Bolongo Bay Road from Intersection Hill going up to Sea View Home to the Bolongo Bay Hotel. Additionally, the flooding problem in the Tutu community is also exacerbated by dense development without regard for natural water runoff and an insufficient drainage system throughout the entire community, but especially along the valley floor. These problems are manifested at the Tutu Fire Station, a critical facility and adjacent to Metro Motors and Gomez school.

Charlotte Amalie is also impacted by flooding. This historic community does not have adequate systems for water runoff causing flooding to the business district and adjacent areas. There are a few guts for runoff but their maintenance is not consistent and of their overflow is frequently due to debris accumulation. The major runoff system is the Frenchtown Gut. This has a shallow pitch that flows into the harbor and in the event of torrential rains tends to backup and flood a rather large surrounding area. The historic business district is prone to shallow flooding that is caused by lack of an ample drainage infrastructure.

Throughout the island there are other areas of localized flooding where development and insufficient drainage systems allow for water accumulation. Severe flooding has taken place on lower Commandant Gade (Garden Street) and Norre Gade (Main Street) where commercial and residential structures have been flooded. Further to the west of town, existing storm water drainage infrastructure systems on highway from Pueblo to Addelita Cancryn School (sub base) and from Pueblo (sub base) to Crown Bay Port Facility continue to flood and cause traffic disruption, particularly when cruise ships are in port. Inadequate storm

water drainage infrastructure continues to plague residential areas of Bournefield north through Kirwin Terrace Public Housing Units.

The geology of St. Croix is vastly different from either St. John or St. Thomas. The geologic history of the island is of a sedimentary origin and the major rock formations are limestone. The result is a landscape with much less topographic relief than St. Thomas. The center of the island is relatively flat, almost a plateau type of landscape. The steep terrain on the island is found along much of the coastline and in hilly, rolling terrain in the northwest portion of the island. There are extensive areas of riverine floodplains throughout St. Croix. However, due to the generally hilly rather than mountainous terrain, the natural flow of runoff water is less rapid causing the accumulation of flood waters to dissipate more slowly.

Consequently most natural waterways are subject to shallow flooding with a slow rise in flood depths. This is prevalent in Estate Welcome, Mon Bijou, La Reine, Williams Delight, Hannah's Rest, St. Georges and areas along Center Line Road. Western areas of Christiansted are prone to flooding in which problems are caused principally by poor siting design and/or developments without regard to adequate drainage systems. Improper drainage systems on road ways have exacerbated problems and have increased downstream flooding in areas like Gallows Bay and Spring Gut; in the vicinity of Paul E. Joseph School; the Grove at La Raine; Frederiksted Lagoon Area; on Prince Street (Christiansted); on King Cross Street (Christiansted); Fort Frederik Beach; East Golden Rock on Rt. 75 (North Shore Road) and the La Grange Gut and associated drainage systems.

***FIGURE 4.10* Riverine Flooding Hazard, St. Thomas**

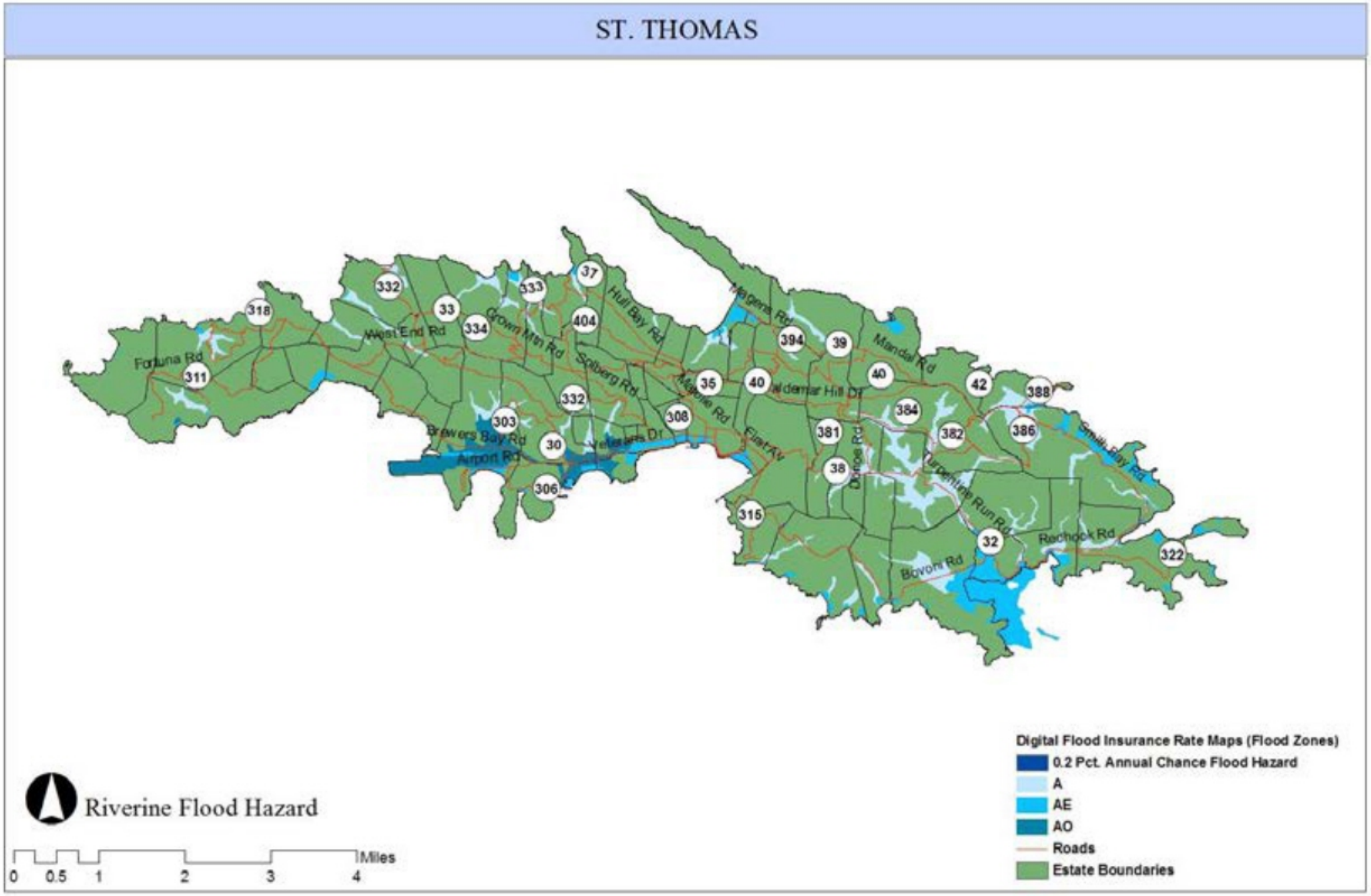


***FIGURE 4.11* Riverine Flooding Hazard, St. Croix**

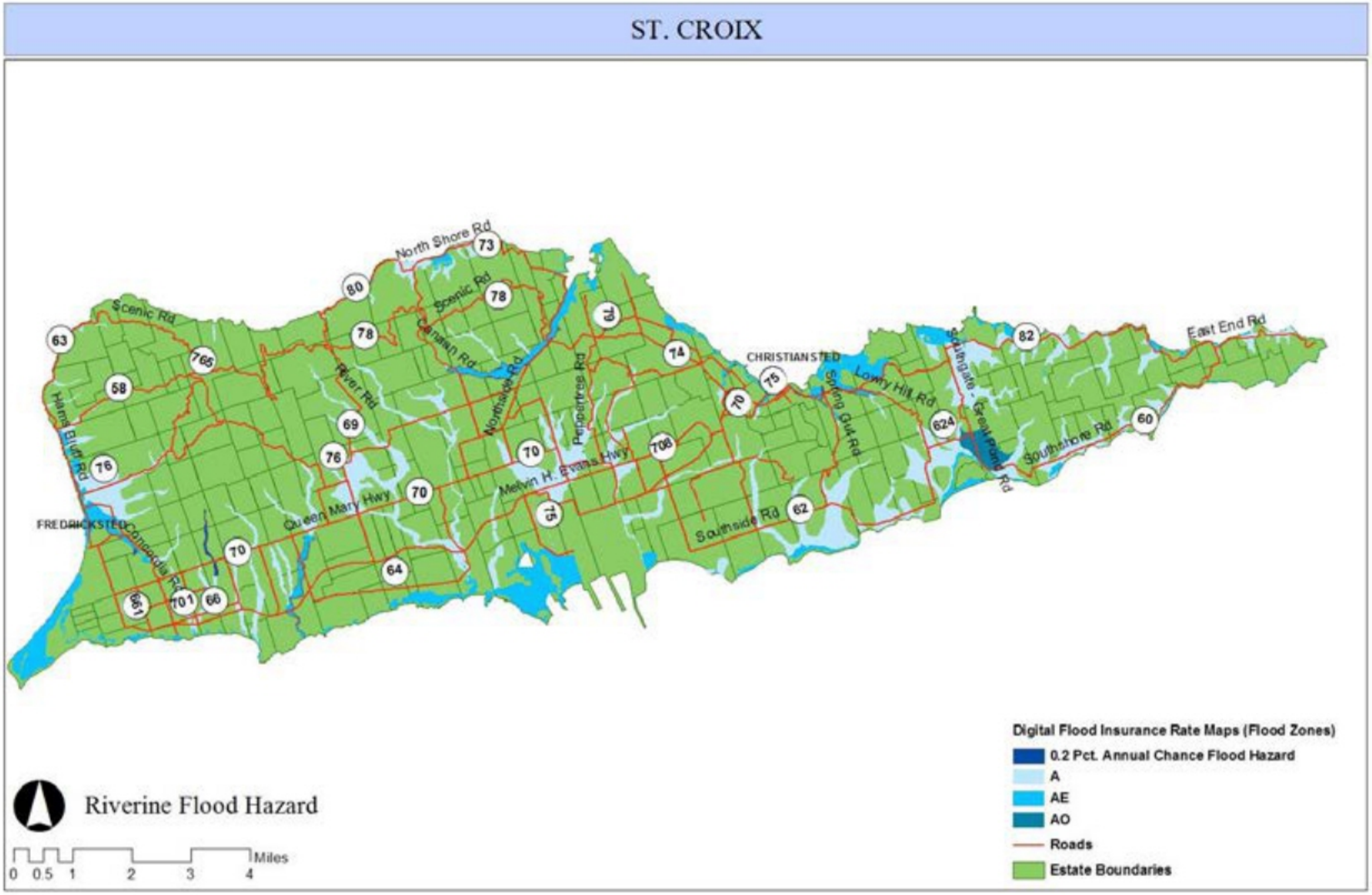
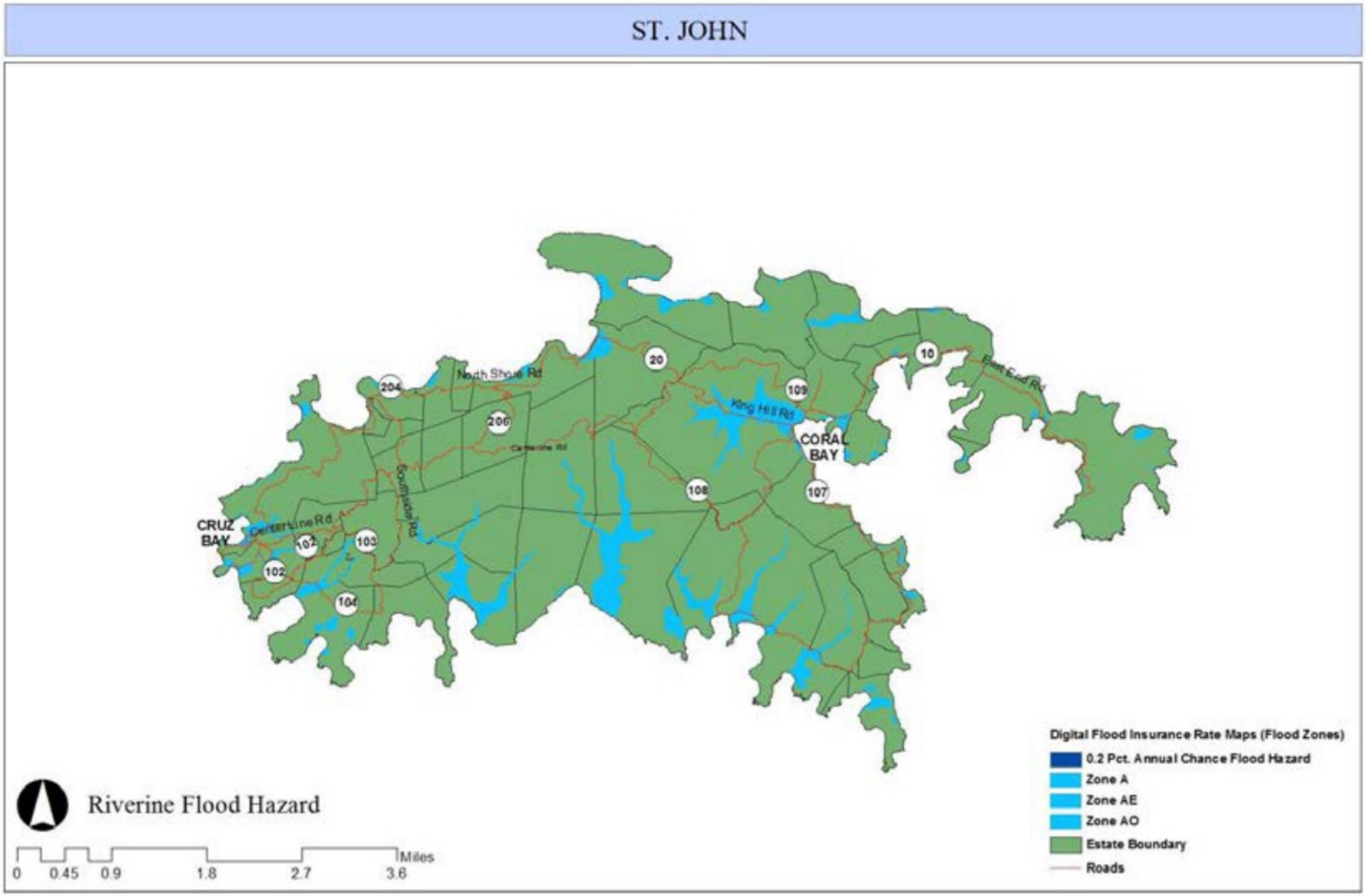


***FIGURE 4.12* Riverine Flooding Hazard, St. John**



## Disaster History

Since the 2008 Plan development, there have been 4 Federal disaster declarations, of which 2 have been caused by a prolonged period of heavy rainfall. There is a lengthy record of the rainfall amounts that have occurred in the US Virgin Islands. There is also a good understanding of the factors that lead to riverine flooding as it is experienced in the US Virgin Islands as explained above. However, reliable records for specific occurrences of inland flooding are scarce which makes the reconstruction of many past floods and the determination of recurrence intervals difficult if not impossible. There are studies that have attempted to link higher than normal rainfall events with probable flood events but the results are not conclusive. But, there are good records for a few recent events.

In 2003, heavy rains over the US Virgin Islands during the week of November 12th led to widespread flash flooding. The US Virgin Islands was declared a federal disaster area with damages estimated at $25-30 million. The storm was the result of a two-day period with a stationary area of low pressure, which led to widespread and continuous rainfall across all the US Virgin Islands resulting in generalized flash floods and riverine flooding. This two-day period was followed by a series of showers that lasted for several more days. With the previous heavy rains, the ground was so saturated that most of the subsequent rain became runoff and contributed to additional flooding problems. The four-day accumulation of rain varied from 15 to more than 20 inches across the Islands.

Other significant flooding events have occurred on the island of St. Croix. In November 2004 heavy rains caused severe roadway flooding from Estate Mount Welcome to Gallows Bay depositing large quantities of dirt and debris at the Gallows Bay intersection. There was also general street flooding in Christiansted. In May 2005, severe thunderstorms brought as much as 2 and 3 inches of rain in a one hour period, causing wide spread street and gut flooding in town (Christiansted).

During October 2006, flash flooding caused an accumulation of one foot of water in the Gallows Bay area. This weather system also flooded portions of Mon Bijou, La Reine, Williams Delight, Hannah's Rest, St. Georges and areas along Centerline Road. This system also forced school and business closures. The areas on St. Croix most affected by this event were western suburbs of Christiansted. However, excessive flooding was also reported in Frederiksted, along the South Shore Road and the Northside Road.

In November, 2010, the Territory experienced torrential downpours associated with Tropical Storm Otto and Tomas. The flooding caused extensive damages throughout the islands and flooded cars, businesses, homes and streets. Areas of Charlotte Amalie were affected on St. Thomas where several stores in the historic shopping district were flooded. The Diamond Center was flooded with more than 2 feet of water. On Brookman Road, the tremendous volume of water rushing over the asphalt caused it to lift, prompting temporary closure of that road.

The passing of these systems presented major challenges to the Public Works crews, and while all roads on St Thomas and St John were passable, DPW recommended caution given the saturated soil conditions.. On St. John, flooding was particularly severe in the area of Enighed Pond. Sewers were overwhelmed in several locations and manhole covers were carried away as dirty water flowed down the streets.

On St Croix, roadways flooded and water pooled in several urban areas in Christiansted and Fredricksted, in places where motorists had not seen water standing before, causing some to stall out in the heavy downpours. The runoff from the rains collapsed a section of roadway that spans Gut#5 within Enfield Green cuttingthe Westside of that neighborhood off to vehiclar traffic and leaving no exit. The rush of rain runoff coming down from the hills and making its way to the sea overwhelmed storm water drainage infrastructure in William's Delight and Enfield Green. This high velocity flow caused a culvert crossing on the road within Enfield Green to give way.

In La Vallee on the island's North Shore, landslides and localized flooding in low-lying areas created some hazards by pushing debris into the roadways. There were weather-related electrical failures in Orange Grove, LBJ Gardens, Montpellier, Betsy Jewel, Grove Place, La Reine, Castle Coakley, Whim, William's Delight, Two Williams, Mt. Pleasant, Shoys, La Grange, Butler Bay, Spring Garden, Northside, Nicholas, Frederikshaab, Wheel of Fortune, Little Princess Hill, St. John, Grange Hill, Brookshill, Turner Hole, New Works, Bethlehem, and Mon Bijou.

## Climate Variability, Hazard Frequency and Magnitude

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical rainfall records and physical land characteristics to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

A specific flood that is used for a number of purposes is called the “base flood” which has a 1% chance of occurring in any particular year. The base flood is often referred to as the “100-year flood” since its probability of occurrence suggests it should only reoccur once every 100 years, although this is not the case in practice. Experiencing a 100-year flood does not mean a similar flood cannot happen for the next 99 years; rather it reflects the probability that over a long period of time, a flood of that magnitude should only occur in 1% of all years.

**TABLE 4.6 *Flood Probability Terms***

| Flood Recurrence Intervals | Chance of occurrence in any given year |
|---|---|
| 10 year | 10% |
| 50 year | 2% |
| 100 year | 1% |
| 500 year | 0.2% |

While the FEMA flood maps that were utilized for this assessment they do not incorporate the impacts of climate change, it will become an increasing important parameter for predicting flood hazard and mapping the extent of flood hazards.

To incorporate climate change into flood models FEMA flood mapping experts must work to incorporate projected data for future climatic conditions into hydrological and hydraulic models, which can be used to delineate the extent of flooding for certain return periods.

Since climate models indicate that there is a likely to be a potential increase in extreme rainfall events, it will be important to monitor such data to understand changes in susceptibility to flooding due to climate change throughout the territory. Greater frequency of intense rainfall events will translate into larger

(deeper and more widespread) floods occurring in the Territory more often. Table 4.6 shows a range of flood recurrence intervals and their probabilities of occurrence.

The extent of flooding associated with a 1% probability of occurrence – the base flood - is used as regulatory boundaries by Federal, state and local agencies. Also referred to as the "Special Flood Hazard Area (SFHA)" (see Figures, 4.10, 4.11 and 4.12), this boundary is a convenient tool for assessing vulnerability and risk in flood prone communities, since many communities have maps available that show the extent of the estimated base flood event.

## Data Sources, Models and Methodologies

Information for the development of the Riverine Flood Risk Assessment came from a variety of sources, including:

**Base Data (Riverine Flooding)**

- FEMA Digital FIRM data, which delineate the 100- year floodplain and VE SFHA boundaries
- USACE Digital Terrain Model

**Riverine Flood Hazard Assessment and Determination**

- FEMA Digital FIRM data were identified as the most comprehensive flood polygon data for the US Virgin Islands. This data was updated in April, 2007. GIS overlay techniques were utilized to identify structures in the flood zone flood polygons. Flood depths were estimated for each estate on each island by overlaying the Q3 flood zone data on a digital elevation model.

**Inventory Data (Assets)**

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

## 4.4.5 COASTAL FLOODING & EROSION

### Hazard Description

The most dangerous and damaging feature of a coastal storm is storm surge. Storm surges are large waves of ocean water that sweep across coastlines where a storm makes landfall. The more intense the storm, the greater the height of the storm surge.

Storm surge areas can be mapped by a number of computer-driven models. The coastal hazard mapping was developed for the USACE using the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) computer model (developed by the National Weather Service to forecast surges that occur from wind and pressure forces of hurricanes), Bathymetry and coastline topography. The SLOSH model was developed primarily as an emergency management tool to aid in evacuation planning. In the USVI, hurricane category is the predominant factor in "worst case" hurricane surges. The resulting inundation areas are grouped into Category 1 and Category 3, and Category 5 classifications. The hurricane category refers to the Saffir-Simpson Hurricane Intensity Scale described in Table 4.7.

**TABLE 4.7** ***Saffir-Simpson Hurricane Scale***

| Category | **Storm Surge** (feet above normal sea level) |
|---|---|
| **1** | 4–5 ft. |
| **2** | 6–8 ft. |
| **3** | 9–12 ft. |
| **4** | 13–18 ft. |
| **5** | > 18 ft. |

The IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) indicates that the frequency of the most intense storms and associated storm surges or coastal floods is more likely than not to increase by more than +10% (IPCC 2013, AR5), while the annual frequency of tropical cyclones and associated storm surges or coastal floods are projected to decrease or remain relatively unchanged for the North Atlantic.

This suggests no major change in the frequency of hurricanes and associated storm surges or coastal floods in North Atlantic region comprising US Virgin Islands. The model, however, that sea level rise is projected to increase by small magnitude of 0.35 m over the projected for the 2040s relative to the 1960-1990 baseline. These projections have implications for the USACE's SLOSH (Sea, Lake, and Overland Surges from Hurricanes) computer model (developed by the National Weather Service) that was utilized for this study and could increase the expected surge levels in Table 4.7 above.

Such parameters can be used by the USACE and NWS to understand the potential impact of climate change on coastal inundation levels and magnitude (Table 4.7).

As indicated in the 2011 plan, storm surge inundates coastal areas, washes out dunes, causes backwater flooding in rivers, and can flood streets and buildings in coastal communities. The biggest impact coastal flooding has is the wearing away or eroding of coastal land, which is commonly described as **coastal erosion**. While erosion is considered a function of larger processes of gradual shoreline change, which includes erosion and accretion, it is tied in the US Virgin Islands to hurricane events. This is particularly true in the short-term, where storms can erode a shoreline that may, over the long-term, be accreting.

- Erosion results when more sediment is lost along a particular shoreline than is re-deposited by the water body.
- Accretion results when more sediment is deposited along a particular shoreline than is lost.

Over a long-term period (years), a shoreline is considered to be either eroding or accreting or stable. It is very difficult to measure erosion as a rate, with respect to either a linear retreat (i.e., feet of shoreline recession per year) or volumetric loss (i.e., cubic yards of eroded sediment per linear foot of shoreline frontage per year). This is primarily due to the fact that erosion rates are not uniform, and vary over time at any single location.

## Nature of the Hazard

Coastal flooding in the US Virgin Islands is common and associated with low-pressure systems, including tropical storms and hurricanes. In the limited shoreline areas of the US Virgin Islands coastline that slopes gradually inland, the coastal areas are also vulnerable to large coastal sea swells generated by winter storms over the Atlantic Ocean. Rising storm surge levels are a function of wind, atmospheric pressure, tide, waves, and/or swell. Coastal topography and immediate offshore bathymetry (sea bottom contours) directly affect the extent of coastal flooding.

Shoreline changes, on the other hand, are the result of both natural forces and human activities, such as sand mining and beach construction. Environmental awareness has been slowly growing. Hurricane events, such as Hurricane Hugo, Marilyn and Lenny, have illustrated the vulnerability of the US Virgin Islands' beaches. High waves and tides and ocean currents accompanying these storms, are the most significant forces affecting erosion in the US Virgin Islands. Their turbulent energy stirs up and moves the beach sand, eroding the coastline.

## Hazard Location, Extent and Distribution

Figure 4.13, 4.14, and 4.15 illustrate the geographic coverage of coastal flooding on the three major islands. The high winds literally pile the water up to create storm surges. The coastal hazard mapping was developed for the USACE using the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) computer model and indicates that the following areas are most susceptible to storm surge on an island by island basis:

- **St. Croix** – Events like Hurricane Hugo were major disaster events due to high winds. However, historically, storm surge has probably been associated with more fatalities. On St. Croix,

Christiansted and Frederiksted are located such that it would take an improbable strike to generate significant water threats. Nevertheless, they are at high risk from storm surge if hurricane forces are aggravated by severe wave conditions. Increased industrial and commercial construction in coastal areas has resulted in the removal of coastal vegetation such as mangroves and grasses which have increased vulnerability to coastal flooding.

- **St. John** – Cruz Bay is at risk to storm surges and any waterfront developments along the coastline that could be affected by a surge up to a maximum of 12 feet in elevation above mean sea level.
- **St. Thomas** – In terms of specific locations, Charlotte Amalie and Red Hook are most vulnerable from increased water heights along with much of the shoreline development between those two locations. Although strong storm surges from the south or west are much less frequent, the marinas and large waterfront developments along St. Thomas' south coast would be severely impacted by a large storm from that direction. There are two very large school facilities (Charlotte Amalie High School and Eudora Kean Gymnasium at Red Hook) that offer considerable safe refuge from storm surge. One of their favorable aspects is that they can be accessed by walking.

In addition to Hurricanes, swell waves that are experienced in the US Virgin Islands between the months of October and April may have an impact on USVI shorelines. The storms are caused by intense mid-latitude storms in the North Atlantic and travel thousands of kilometers south to affect the west, north and east coasts of the islands.

**<u>FIGURE 4.13</u>** ***Coastal Flooding Hazard Map, St. Thomas***

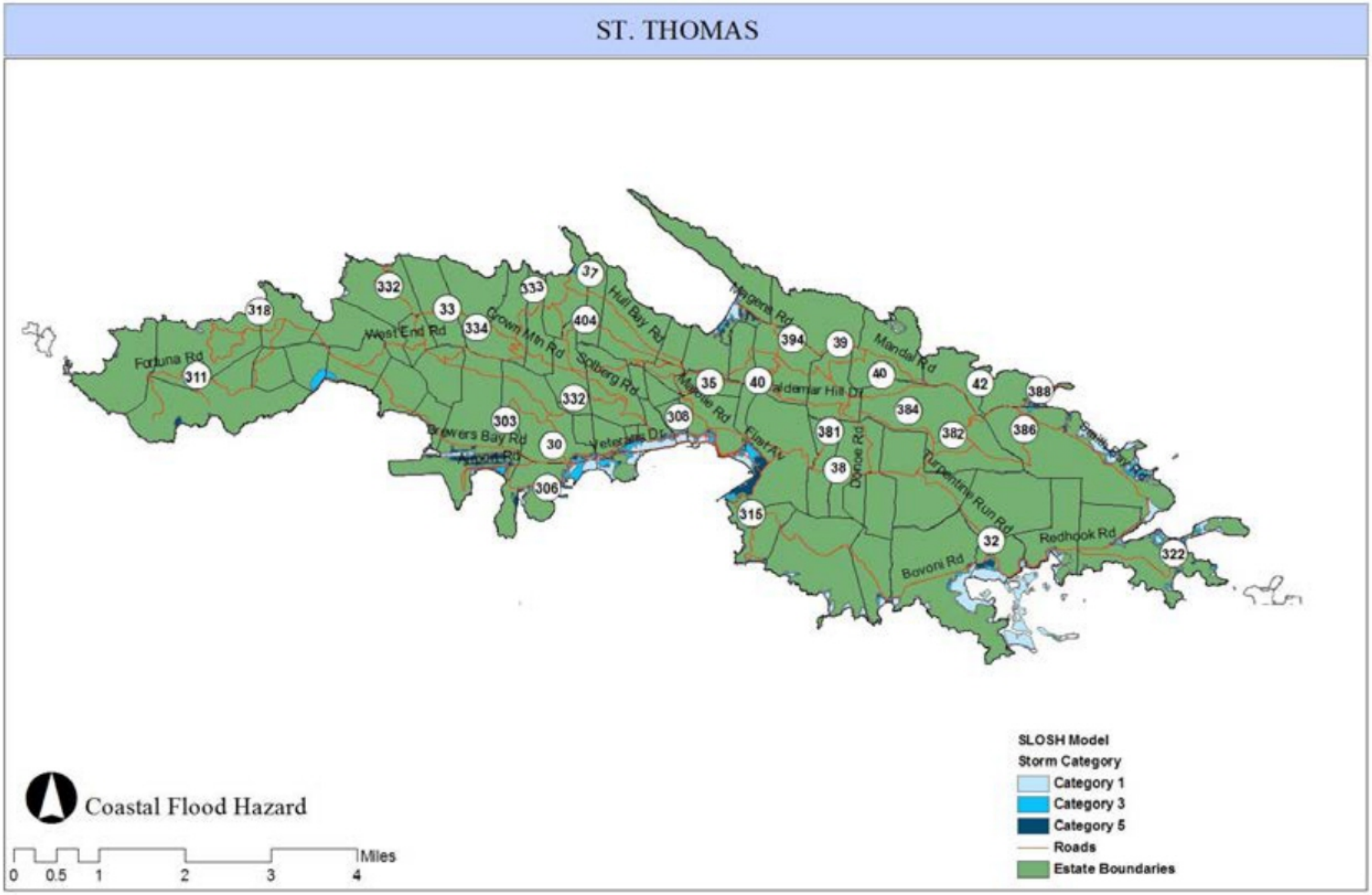


**FIGURE 4.14** ***Coastal Flooding Hazard Map, St. Croix***

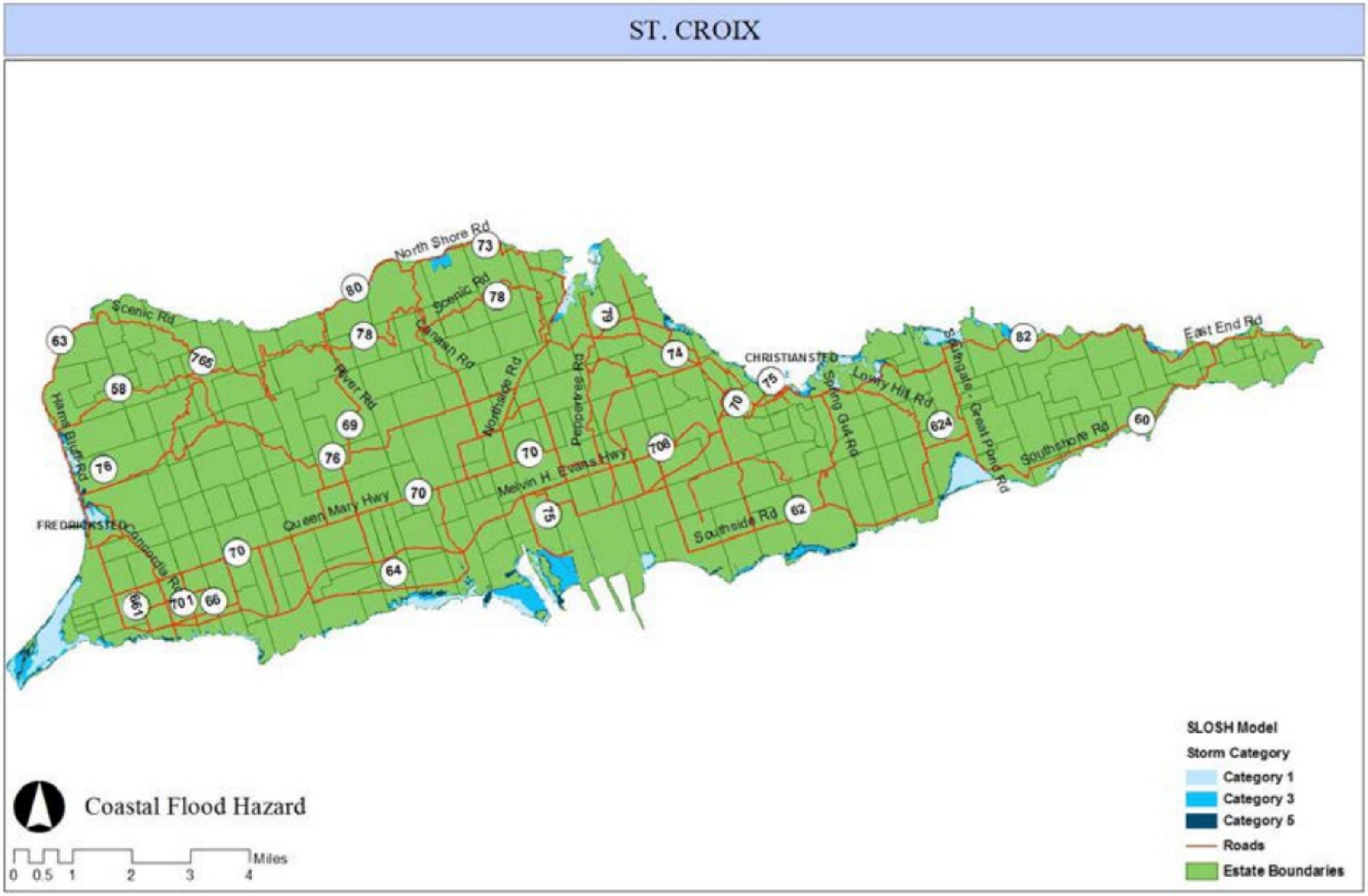
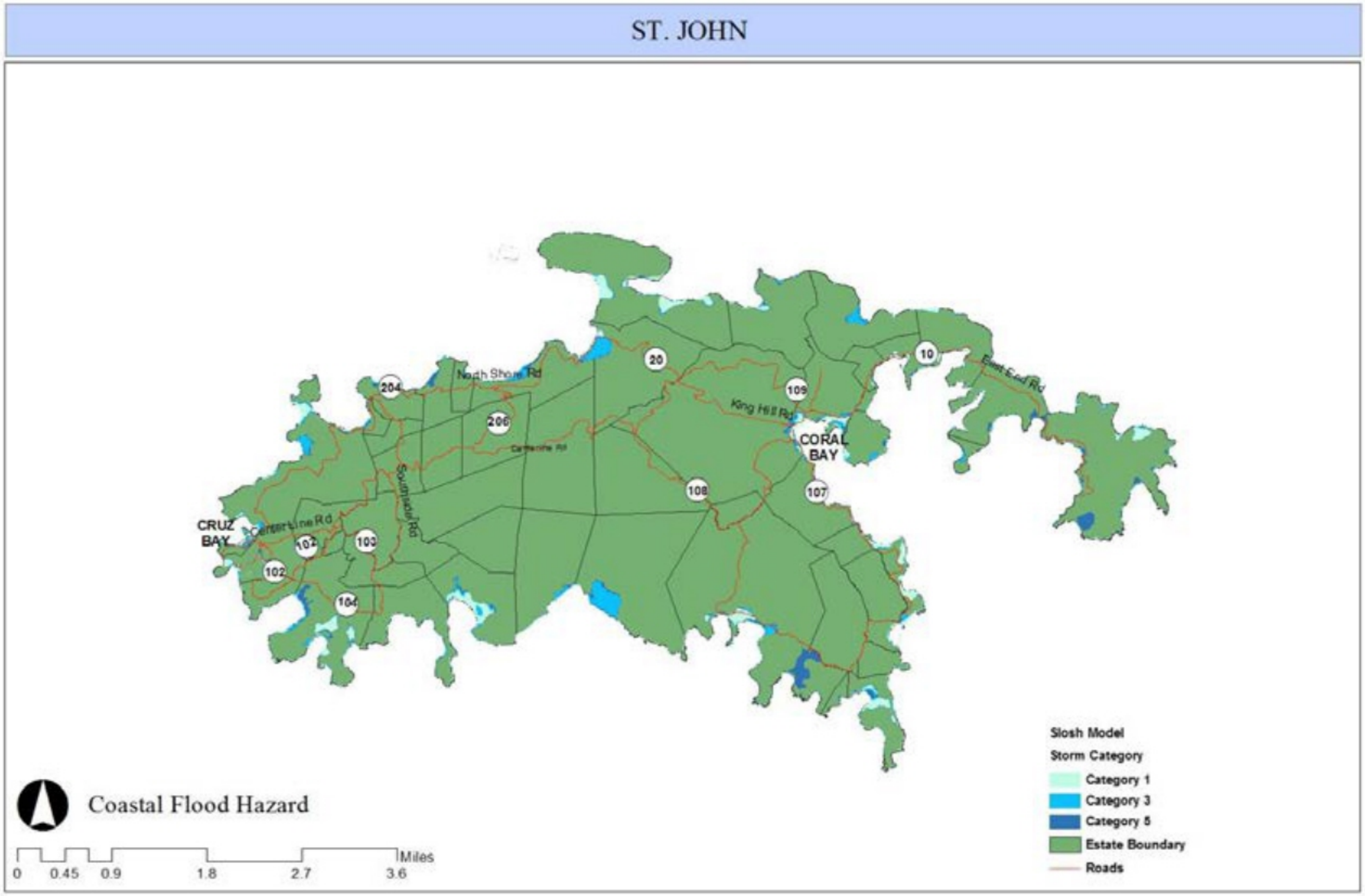


**FIGURE 4.15** *Coastal Flooding Hazard Map, St. John*



## Disaster History

Since the last Plan Update (2011), there have not been any major coastal flooding Federal disaster declarations that have caused damage to residential and/or commercial buildings. During the last planning period (2008-2011), Hurricane Earl was the strongest storm to past the islands, but did not have much impact on the shorelines besides washing several boats ashore.

There is limited available information from the US Virgin Islands that isolates coastal flooding from other hazard impacts. One undocumented source lists 15 recorded accounts of storm surges in the local news records from 1867 to 1960. These ranged in magnitude from as little as 1 foot in elevation to the 12 foot mark in 1867. Nearly one half of the occurrences recorded maximum surge elevations of at least 8 feet with commensurate damage.

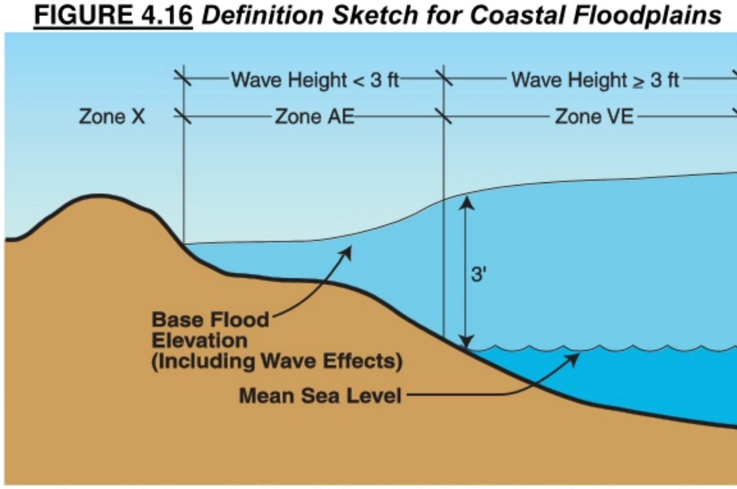
During Hurricane Lenny, tremendous storm surge and wave action affected structures well inland of the coastal high hazard zone (Zone VE) as shown on the FIRMs. The beach and dune systems in the coastal impact areas were destroyed causing increased storm surge inundation levels and wave action in areas previously modeled as being outside the Zone VE.

Between September 16-21, 2010, large, long-period northeast and then north swells of 9 to 13 feet generated by Hurricane Igor began affecting the U.S. Virgin Islands. These long period swells produced very large breaking waves of 15 to 20 feet or higher along local reefs, beaches, and shoals of the local islands. The swells produced minor coastal flooding, beach erosion, and minor structural damage. There was one reported drowning near the Carambola Beach Resort, 2 miles northeast of Christiansted, Saint Croix.

## Climate Variability, Hazard Frequency and Magnitude

Much like riverine flooding, predictive modeling has been used by FEMA to create NFIP mapping that reflects the 1% recurrence interval events for storm surge or coastal flooding.

**FIGURE 4.16** ***Definition Sketch for Coastal Floodplains***




Source: Understanding Your Risks – FEMA Publication 386-2, Page 2-24

While the “100-year floodplain” for inland and coastal purposes is usually referred to as the “A” zone, there is an additional designation in coastal areas, a “V” or “VE” zone that is the area subject to the 1% recurrence interval flood and in areas where the flood waters create waves that are 3 ft. or greater in height, are anticipated to be moving with velocity and associated forces. The velocity and force of the water make storm surges even more destructive than riverine flooding.

In low-lying coastal areas, such as estuaries, wetlands and mangroves, storm surge can cause problematic saltwater intrusion into freshwater systems. As rising water levels submerge low-lying portions of the lands, it has the potential disrupt sensitive ecosystems and potential diminish critical habitat for larval fish, natural sinks for sediments and pollutants, natural storage for floodwaters, and a cherished aesthetic quality of coastal regions (Incorporating Sea Level Change Scenarios at the Local Level, NOAA 2012).

However, to be consistent with the USACE SLOSH Model that depicts coastal hazard areas for Category 1, 3, and 5 hurricane events. There is an estimated 5% chance for the Territory to experience a Category 3 hurricane each year and the estimated annual probability of experiencing a Category 5 event is less than one percent a year.

## Data Sources, Models and Methodologies

Information for the development of the Coastal Flooding Risk Assessment came from a variety of sources, including:

**Base Data (Coastal Flooding)**

- USACE SLOSH Model for Categories 1, 3, and 5 storms.
- USACE Digital Terrain Model

**Coastal Flood Hazard Assessment and Determination**

- USACE inundation maps derived from a SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model computes storm were identified as the most comprehensive coastal flood polygon data for the US Virgin Islands.
- Surge inundation polygons were developed for three categories of hurricanes as defined by the Saffir-Simpson scale (Categories 1, 3, and 5).
- GIS overlay techniques were utilized to identify structures in the coastal flood polygons.
- Flood depths were estimated for each estate affected by coastal flooding by overlaying the Q3 flood zone data on a digital elevation model.
- NOAA Coastal service Center, Incorporating Sea Level Change Scenarios at the Local Level, NOAA 2012

**Inventory Data (Assets)**

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

## 4.4.6 HURRICANE WINDS

### Hazard Description

Hurricanes and tropical storms are large-scale systems of severe thunderstorms that develop over tropical or subtropical waters and have a defined, organized circulation. Hurricanes have a maximum sustained (meaning 1-minute average) surface wind speed of at least 74 mph; tropical storms have wind speeds of 39 mph to 74 mph.

Hurricanes and tropical cyclones get their energy from warm waters and lose strength as the system moves inland. Hurricanes and tropical storms can bring severe winds, inland riverine flooding, flooding in coastal areas, storm surges, coastal erosion, extreme rainfall, thunderstorms, lightning, and tornadoes. Hurricanes and tropical storms typically have enough moisture to cause extensive flooding throughout the Territory, often to the 100- or 500-year flood elevations. However, this subsection is focused on Hurricane Winds; flooding effects of hurricanes and tropical storms are covered in Sections 4.4.4 and 4.4.5 – Riverine and Coastal Flooding, respectively.

Hurricane magnitude is measured on the Saffir-Simpson hurricane scale, shown in Table 4.8, which categorizes hurricane magnitude by wind speeds and storm surge above normal sea levels.

**TABLE 4.8** ***Saffir-Simpson Hurricane Scale***

| Category | Wind Speed | Expected Damage |
|---|---|---|
| **1** | 74–95 mph | **Minimal**: Damage primarily to shrubbery and trees; unanchored mobile homes damaged; some damaged signs; no real damage to structures. |
| **2** | 96–110 mph | **Moderate**: Some trees toppled; some roof coverings damaged; major damage to mobile homes. |
| **3** | 111–130 mph | **Extensive**: Large trees toppled; some structural damage to roofs; mobile homes destroyed; structural damage to small homes and utility buildings. |
| **4** | 131–155 mph | **Extreme**: Extensive damage to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail. |
| **5** | > 155 mph | **Catastrophic**: Considerable and widespread roof damage; severe window and door damage; extensive glass failures; entire buildings may fail. |

### Nature of the Hazard

The US Virgin Islands of the Caribbean are among the most hurricane-prone locations in the world. While the Atlantic Basin hurricane season officially extends from June 1 to November 30, over the last 117 years, the US Virgin Islands has experienced hurricanes no earlier than July 7th (unnamed storm in 1901) and as late as November 23rd (Hurricane Lenny in 1999).

In 2008, Hurricane Omar (2008) passed over the US Virgin Islands and caused damages to critical facilities and infrastructure that was estimated to be $2.2 million; while Hurricane Earl (2010), a much bigger storm,

passed north of the Territory and caused $2.1 million in estimated damages. The Territory also experienced severe storms, flooding, rockslides, and mudslides associated with Tropical Storm Tomas in late November 2010.

The peak of activity occurs in September with half of the number of average annual storms occurring in that month.

## Hazard Location, Extent and Distribution

One of the most serious components of hurricanes is high winds. Because of the extensive size of a catastrophic hurricane a storm need not pass directly over the Territory to cause severe damage. A hurricane passing within close proximity can also cause major damage to property and even loss of life. Due to the relatively small geographical size of the Territory, any storm passing within a radius of 100 miles is a potential for property loss. Within the past three years four Tropical Storm systems passed within this radius. Accompanying coastal and riverine flooding have a strong spatial context and are addressed in the later sections of this Plan.

Essentially there are no areas of the US Virgin Islands that are free from hurricane force winds. The coastal and low lying areas experience the first effects of damaging winds, but due to the hilly and mountainous nature of the Territory, winds are funneled in gullies and passes between mountainous terrain seeking to traverse the mountains and ridges, and are often compacted and intensified causing damage to structures at higher elevations. While the entire territory is exposed to hurricane winds, there are variations in vulnerability primarily due to the number of properties and type of construction. The newer construction structures that have been built to codes are less vulnerable than the older structures. Another factor is the type of construction – i.e. wood frame structures – that are more susceptible to damages than reinforced concrete. The differences in vulnerability for each island in the Territory are highlighted in Section 4.5 below.

## Disaster History

For this Plan Update, there have been no federal disaster declarations. Since the 2005 Plan, Tropical Storm Dean (8/17/07) traversed south of the Virgin Islands. Minimal damage was sustained and limited for the most part to downed trees and coastal road erosion. Between 1887 and 1989, 36 hurricanes passed within 125 miles of the US Virgin Islands (USACE *Hurricane Evacuation Study*, 1994).

Of the 22 most deadliest, costliest, and most intense hurricanes to strike outlying US territories and the State of Hawaii over the past 100 years, 7 have struck the US Virgin Islands including:

- San Ciprian (1932). US Virgin Islands and Puerto Rico (PR). Damages estimated at $494 million,
- San Mateo (1949). St Croix. Damages unknown,
- Donna (1960). St. Thomas and PR. Damages unknown,
- Hugo (1989). US Virgin Islands and PR. Damages estimated at $1.4 billion,
- Marilyn (1995). US Virgin Islands and PR. Damages estimated at $1.8 billion,

- Georges (1998). US Virgin Islands and PR. Damages estimated at $1.9 billion, and
- Lenny (1999). US Virgin Islands and PR. Damages estimated at $342 million.

*Note: Damage estimates include Puerto Rico and were adjusted for inflation (NOAA 2004); damages for Omar and Earl are from Preliminary Damage Assessment Reports.*

In 2004 four major storms passed through the Caribbean causing varying levels of damage with one – Tropical Storm Jeanne – resulting in a presidential disaster declaration. Tropical Storm Jeanne affected the Territory with high winds and torrential rains inflicting a total of $6.4 million in damage, mostly to the infrastructure, with downed power lines and damaged or debris filled roadways. Most damage was caused on St. Croix, but all three islands of the Territory experienced damage and received excessive rainfall and record flood levels. The damages associated with the Omar 2008 ($2.2 million) and Earl 2010 ($2.1 million) are minor in comparison.

The majority of presidential declarations in the US Virgin Islands result from hurricanes. A brief description of some recent hurricanes that have impacted the US Virgin Islands follows:

- **Hurricane Klaus** (October 1984). Hurricane Klaus traversed the islands leaving moderate damage to roads and bridges, and heavily damaging the Fredericksted Pier in St. Croix. The most significant hazard event was flooding caused by the heavy rains that accompanied the storm.
- **Hurricane Hugo** (September 1989). Hugo passed directly over the Island of St. Croix on a west northwest track at speeds of 3 - 10 mph. Hugo was a destructive Category 5 hurricane when it impacted St. Croix. As a result, St. Croix suffered damages of catastrophic proportion. The center of the storm passed west of St. Thomas, but still inflicted severe damage. St. Thomas received substantial damage to public and private facilities.
- **Hurricane Marilyn**[7] (September 1995). This time, St. Thomas bore the brunt of this large hurricane; the eye of the hurricane was more than 20 miles across. Hurricane Marilyn was at Category 1 strength, and intensified to nearly Category 3 strength by the time it reached the U.S. Virgin Islands. Marilyn caused 10 deaths and left thousands homeless. Marilyn damaged or destroyed nearly all 12,000 homes on St. Thomas and another 5,000 on St. Croix. Damage to commercial and residential roofs was extensive. The damages to the WAPA's electric distribution system alone were estimated at $44 million. The storm also destroyed warehoused food stocks and damaged the only hospital on St. Thomas.
- **Hurricane Lenny** (November 1999). An unusual hurricane that tracked across the Caribbean from the west. Lenny made landfall on the western coast of the St. Croix, causing extensive storm surge damages along it's coastline. Lenny's maximum winds reached 150 mph as it approached the US Virgin Islands.
- **Hurricane Omar** (October 2008). Hurricane Omar weakened from a Category 3 to a Category 1 storm as it quickly moved over the US Virgin Islands. A last minute shift to the east spared St.

[7] Hurricane Marilyn was at Category 1 strength, and intensified to nearly Category 3 strength by the time it reached the U.S. Virgin Islands.

Croix, the most populated of the U.S. Virgin Islands, which received just a glancing blow from the weaker side of the system. Omar knocked down trees, caused some flooding and minor mudslides.

- **Hurricane Earl** (August 2010). Hurricane Earl, a Category 3 storm, passed near or over the northernmost part of the U.S. Virgin Islands. Hurricane conditions spread across the northern U.S. Virgin Islands to Culebra and Puerto Rico. The eye of Earl passed just north of the British Virgin Islands, and its closest point of approach to the U.S. Virgin islands was around 3 pm on the 30th when it was located about 60 miles northeast of St. Thomas. By 5 pm Earl strengthened into a category 4 hurricane, with maximum winds of around 135 mph while it was moving away from the Virgin Islands.

It is important to note that prior to Hurricane Hugo, the last hurricane with winds of Category 3 or greater occurred 73 years earlier in 1916. During the period from 1916 to 1989, dozens of milder tropical storms and hurricanes came in close proximity or made landfall but none caused the damages associated with Hugo and Marilyn.

## Climate Variability, Hazard Frequency and Magnitude

A 1994 study produced for the US Virgin Islands Water and Authority (WAPA)[8] used the available historical record to determine approximate return periods (probability of frequency) for hurricanes of different categories (see Table 4.8: Saffir-Simpson Hurricane Scale). For example, the Territory could expect a Category 3 hurricane once every 20 years as shown on the matrix below. The results are shown in Table 4.9

**TABLE 4.9** ***Frequency of Hurricanes Passing By or Through the US Virgin Islands***

| Intensity | Average Return Period |
|---|---|
| Category 3 | 20 years |
| Category 4 | 50 years |
| Category 5 | 120 years |
| Source: US Virgin Islands WAPA 1994 | |

[8] The study went on to note: "*that the above estimated return periods are for hurricanes with the corresponding intensity level passing by or through the islands and are not the return periods for a direct hit on the islands. Moreover, because the prevailing hurricane direction in this region is from east to west, the chance of a hurricane traveling north and hitting St. Croix first and then St. Thomas and St. John is very small. Thus, the worst possible realistic scenario is for a hurricane track to be located between St. Croix and St. Thomas/St. John having an east/southeast to west/northwest direction.*"

The Atlantic Oceanographic and Meteorological Laboratory's FAQ (Frequently Asked Questions) web site[9] indicates that there is an estimated 42% chance each year of experiencing a strike by a tropical storm or hurricane in the US Virgin Islands. These probabilities were developed from recorded data for the years 1944 to 1999 when a storm or hurricane was within about 100 miles (165 km) of a particular location.

The structure and areal extent of the wind field in tropical cyclones is largely independent of intensity storms and play an important role on potential impacts. With the use of satellite imagery and other instruments, intensity measurements have become more accurate, and as a result, the recorded intensities of wind storms in the Atlantic have been increasing. However, the IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5, 2013) indicates that the frequency of the most intense storms is more likely than not to increase by more than +10% (IPCC 2013, AR5), while the annual frequency of tropical cyclones are projected to decrease or remain relatively unchanged for the North Atlantic. This suggests no major change in the frequency of hurricanes in North Atlantic region comprising USVI and that wind speeds are expected to actually decrease by very small magnitude of 0.25 m/s ( 0.559 mph) over the projected for the 2040s relative to the 1960-1990 baseline.

The design wind speed for the USVI in ASCE 7-05 is 145 mph (3-second peak gust) may actually decline marginally due to climate change projects, if it were indeed related to a return interval. This is equivalent to a Category 3 hurricane on the Saffir Simpson scale. There is an estimated 5% chance of experiencing a Category 3 hurricane each year.

## Data Sources, Models and Methodologies

Information for the development of the Hurricane Risk Assessment came from a variety of sources, including:

**Base Data**

- NOAA National Climatic Data Center.
- American Society of Civil Engineers (ASCE) 7-05 Design Wind Speeds.
- *"Estimation of Potential Hurricane and Earthquake Losses to Water and Power Facilities"* (EQE international, 1994.)
- IPCC AR4, 2007, The IPCC Fourth Assessment Report of the Intergovernmental Panel on Climate Change
- IPCC AR5, 2014, IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change

**Hurricane Hazard Assessment and Determination**

- The American Society of Civil Engineers (ASCE) 7-05 Design Wind Speed maps were the primary data input for the wind hazard model as probabilistic data were not readily available. The ASCE Design Wind Speeds take into account historical events such as hurricanes and tropical storms.

[9] http://www.aoml.noaa.gov/hrd/tcfaq/G11.html

The design wind speed in ASCE 7-05[10] for the US Virgin Islands is 145 Mph. In this study design wind speed refers to the sustained wind velocity that structures should be constructed to withstand without suffering catastrophic or total damage. The maps developed show the frequency and paths of hurricanes with winds of Category 4 or above.

**Inventory Data (Assets)**

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

[10]Note that ASCE wind speeds are 3-second peak gusts

## 4.4.7 RAIN-INDUCED LANDSLIDE

### Hazard Description

Landslides are described as downward movement of a slope and materials under the force of gravity. The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Landslides are influenced by human activity (construction of buildings and highways) and natural factors (soils, precipitation, and topography).

Landslides occur when masses of rock, earth, or debris move down a slope. Therefore, gravity acting on an overly steep slope is the primary cause of a landslide. They are triggered by storms, earthquakes (not addressed in this analysis), and by human modifications to the landscape. Wildfires can increase the probability of rain-induced landslides occurring.

Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during periods of prolonged heavy rainfall, changing the earth into a flowing river of mud. Mudslides can flow rapidly down slopes or through channels and can strike with little or no warning at tremendous speeds. Other types of landslides include: rock slides, slumps, mudslides, and earthflows. All of these differ in terms of content and flow. In the USVI, hydrologic factors (rain, high water table, little or no ground cover) and human factors (development activities such as cutting and filling along roads and removal of forest vegetation) exacerbate the effects of landslides.

### Nature of the Hazard

It is very hard to evaluate the location or geographic distribution of landslides across the U.S. Virgin Islands as there is not a historical record from which to reference the incidences of landslides in the Territory. Landslides occur because of a variety of factors in the Virgin Islands and are dues to such factors as topography, slope, climate, and soils. Locations at risk from landslides include areas with one or more of the following conditions:

- On or close to steep hills;
- Steep road-cuts or excavations;
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground);
- Steep areas where surface runoff is channeled, such as below culverts, V -shaped valleys, and steep intermittent stream channels; and
- Areas where slopes are not maintained or are altered by the property owners (clear-cutting).

Although spatial extent of landslides is hard to determine, human impacts have substantial effect on the potential for landslide failures. Proper planning and geotechnical engineering can be exercised to reduce the threat to people, property, and infrastructure.

## Hazard Location, Extent and Distribution

Figure 4.17, 4.18, and 4.19 illustrate the geographic coverage of areas susceptible to rain-induced landslides on the three major islands. The landslide susceptibility maps were developed as part of this project through a constraint mapping methodology that combined elevation, slope, soils and hydrologic units in a Geographic Information System computer model. The following areas are most susceptible to rain-induced landslides on an island by island basis:

- St. John - Events like the severe rainfall experience in November 2010 triggered landslides along portions Centerline road between Cruz Bay and Coral Bay. Nine areas along Centerline Road were blocked and another major landslide in the Bordeaux Mountain area also blocked a major road.
- St. Thomas. The mountain areas, particularly northern facing slopes of the island are the most susceptible to the landslides. Areas in Dorothea and St. Peter Mountain road are especially prone to this hazard. These areas experienced washouts during the recent heavy rainfall events (November/December, 2010). Higher elevations on southern facing slopes, particularly in the area of Crown Mountain are also susceptible to landslides. On Crown Mountain road, a deluge of water shut down the road. A major landslide just beyond the intersection of Crown Mountain and Scott Free roads occurred, along with other smaller landslides. This left Crown Mountain Road impassable at one point.
- St. Croix. The greater variations of rainfall on St. Croix make the landslide hazard more dispersed. The northwestern part of the island receives the greatest amount of rainfall, and as a result, the northern slopes of the mountainous area are highly susceptible to landslides. There are some central areas with steep slopes in the south central area of the island (outside Christiansted) that are also susceptible to landslides. Eastern portions of the island are less susceptible to landslides, particularly lower portions of watershed basins.

## Disaster History

Almost no published literature on the occurrence of landslides exists for the Virgin Islands[11].
A reconnaissance of landslide potential on St. Thomas (Brabb, 1984) indicates that earthflows, debris slides, and individual boulders are recognized landslide types on St. Thomas. Debris flows are not documented or reported as occurring on this island.

[11] http://isis.uwimona.edu.jm/uds/Land_US Virgin Islands.html

- The largest landslide documented on St. Thomas is 60 meters long and 60 meters wide. It was mapped in an area about 1.5 kilometers north of Charlotte Amalie in 1979.
- On April 18, 1983, a storm drenched Dorothea Bay with nearly 400 millimeters of rain in 14 hours. In addition to extensive flooding, this storm event produced a number of landslides. Two earthflows developed in weathered colluvium (unconsolidated materials of various sizes). These are small features about 30 meters long and 30 meters wide. Very small debris slides occurred in colluvium exposed at the top of some road cuts. Boulders temporarily blocked several roads. One boulder which was 6 meters in maximum diameter traveled 10 meters downslope before stopping next to and above a house (Brabb, 1984).
- St. John (2010) nine (9) landslides occurred along portions Centerline road between Cruz Bay and Coral Bay.
- St. John (2010) another major landslide in the Bordeaux Mountain area also blocked a major road.
- St. Thomas. (2010) a major landslide just beyond the intersection of Crown Mountain and Scott Free roads.

**FIGURE 4.17** ***Landslide Hazard Map, St. Thomas***

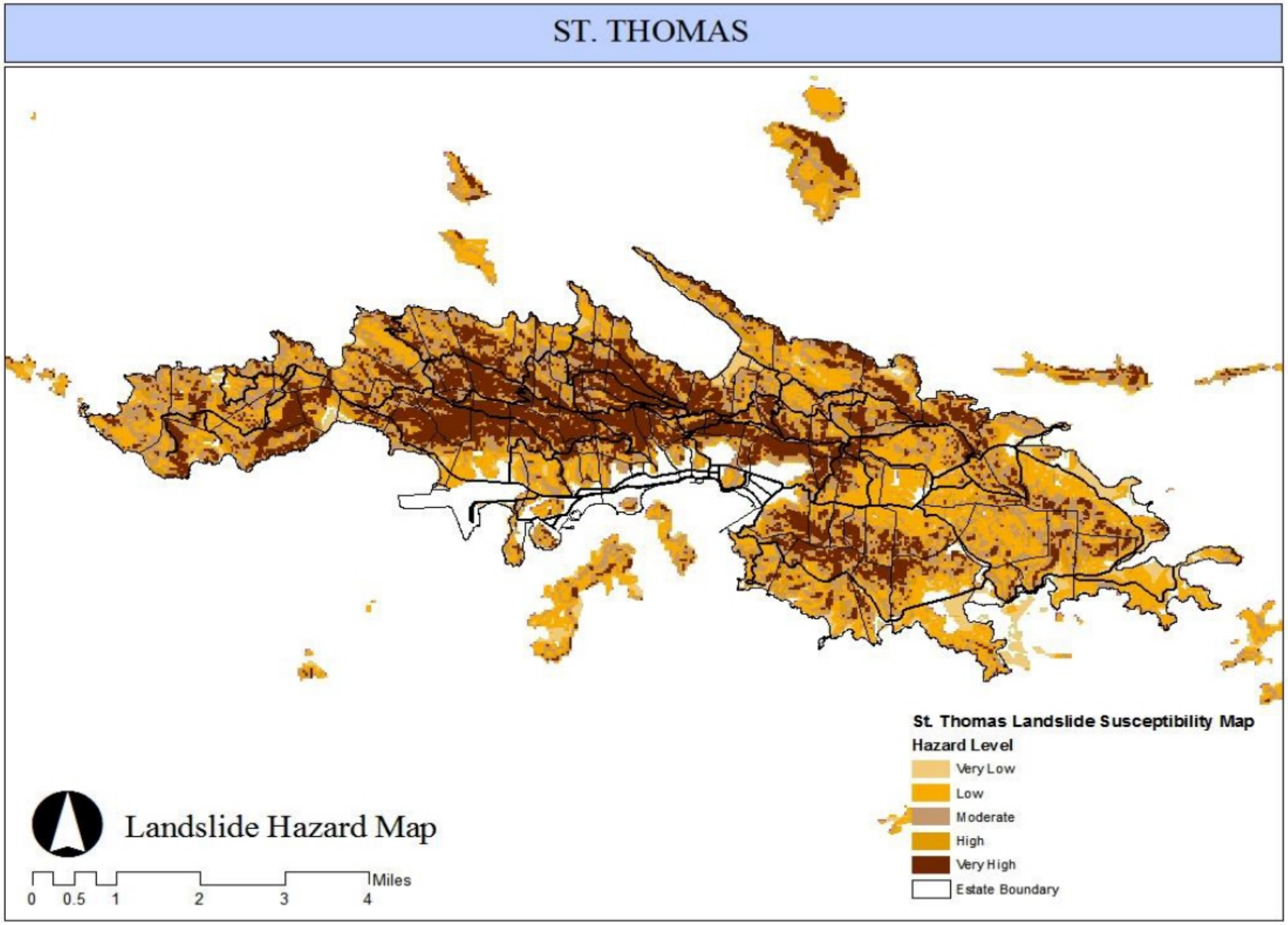


**FIGURE 4.18** ***Landslide Hazard Map, St. Croix***

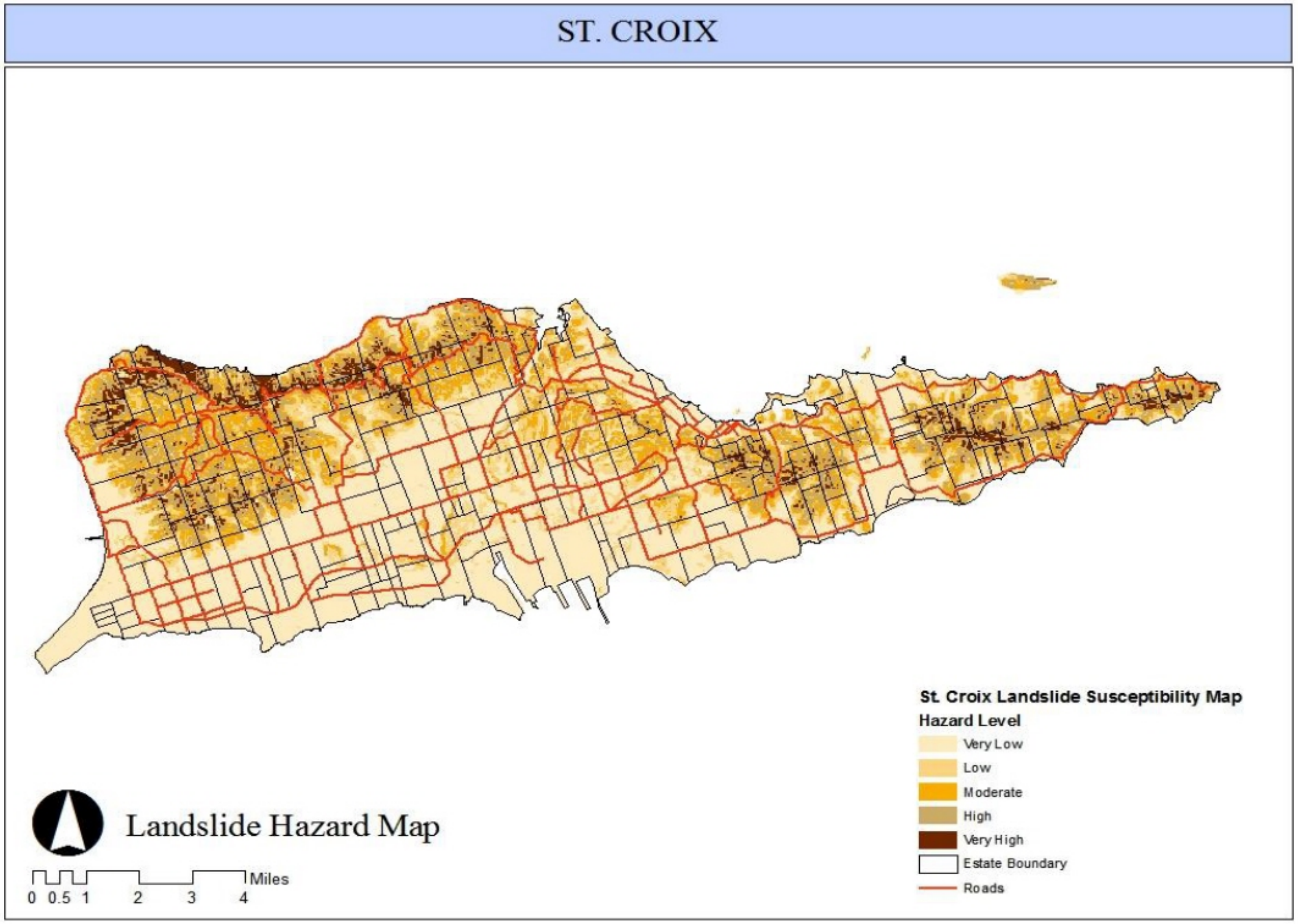
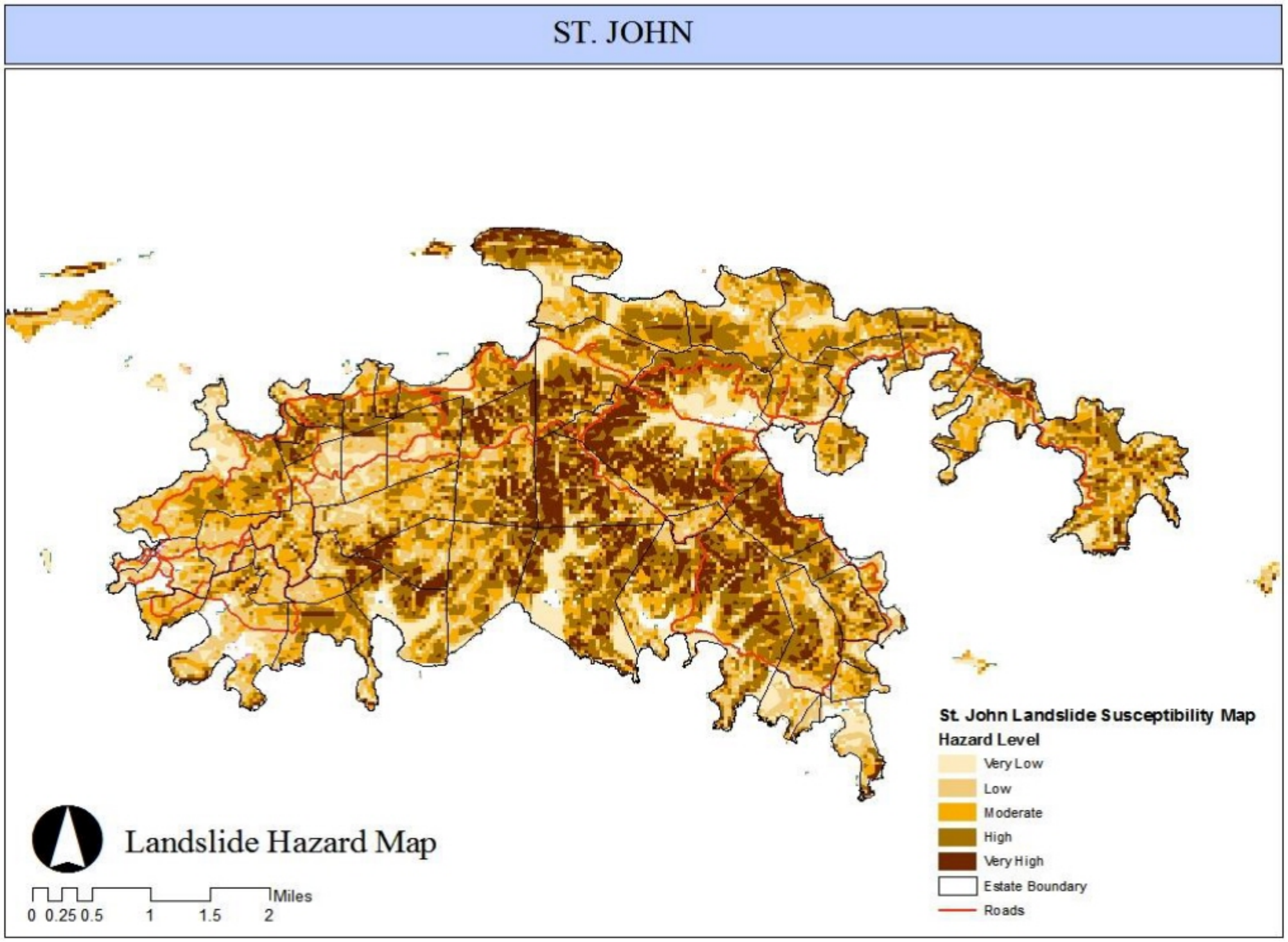


**FIGURE 4.19** ***Landslide Hazard Map, St. John***



## Climate Variability, Hazard Frequency and Magnitude

There is a general lack of understanding and information available to determine the frequency and/or magnitude of landslides in the US Virgin Islands. If we tied the incidence of rain-induced landslides to heavy rainfall events, it appears landslide activity is limited in magnitude as the economic data has not been captured for documenting the impact of each landslide. Based on the limited data, US Virgin Islands (territory-wide) can expect at least one (1) landslide event per year.

The implications of climate variability on the landslide hazard is tied to the intensity of past climate data so as to facilitate an understanding of whether data derived from regional climate models will increase the potential for landslide events in the study area. The hazard model that was used took into consideration precipitation, which indicates that landslide events are triggered by intense precipitation. Therefore, based on the IPCC projections which predict an increase intense precipitation events, the impact f climate change will increase the possibility of experiencing landslides will increase.

To incorporate climate change into future landslide hazard models will necessitate making use of detailed historic records.

## Data Sources, Models and Methodologies

**Base Data**

- (2010): Average Annual Rainfall 1971 -2000, Oregon State University (OSU) Spatial Climate Analysis Service.
- USACE Digital Terrain Model (2008)
- Hydrologic Units for USVI (2002) U.S. Geological Survey in cooperation with the U.S. Department of Agriculture, Natural Resources Conservation Service

**Hazard Assessment and Determination**

- USVI Soil Survey, US Department of Agriculture, Natural Resources Conservation
- Brabb, E.E. 1984. Landslide potential on St. Thomas, Virgin Islands, p.97-102. U.S. Geological Survey Open –File Report 84-762

**Inventory Data (Assets)**

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

## 4.4.8 TSUNAMI

### Hazard Description

A tsunami is a series of long waves generated in the ocean by a sudden displacement of a large volume of water. Underwater earthquakes, landslides, volcanic eruptions, meteor impacts, or onshore slope failures can cause this displacement. Most tsunamis originate in the Pacific Ocean associated with the high level of seismic activity present.

Tsunami waves can travel at speeds averaging 450 to 600 miles per hour. As a tsunami nears the coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. Unusual heights have been known to be over 100 feet high. However, waves that are between 10 to 20 feet high can be very destructive and cause many deaths and injuries. An earthquake need not originate in the near proximity to a land mass to be destructive. Simply put, tsunamis are known to have immediate, intermediate and distant ranges. Destructive waves are known to travel over 1000 miles at alarming speeds. Of course, the closer the epicenter of an event to a land mass, the shorter the period of warning and preparation.

After a major earthquake or other tsunami-inducing activity occurs, a tsunami could reach the shore within a few minutes. From the source of the tsunami-generating event, waves travel outward in all directions in ripples. As these waves approach coastal areas, the time between successive wave crests varies from 5 to 90 minutes. The first wave is usually not the largest in the series of waves, nor is it the most significant. One coastal community may experience no damaging waves while another may experience destructive deadly waves. Some low-lying areas could experience severe inland inundation of water and deposition of debris of more than 1,000 feet inland.

### Nature of the Hazard

Due to the historical record of earthquakes in the region, it is considered reasonable to expect that tsunamis would be generated as well, and the historic record bears this out (see Disaster History below). It is important to note that the sites for tsunami generation are likely to be very close to the coast and so warning time is very short. Therefore, the types of strategies that will be more effective focus on proper siting of structures as opposed to implementing warning systems.

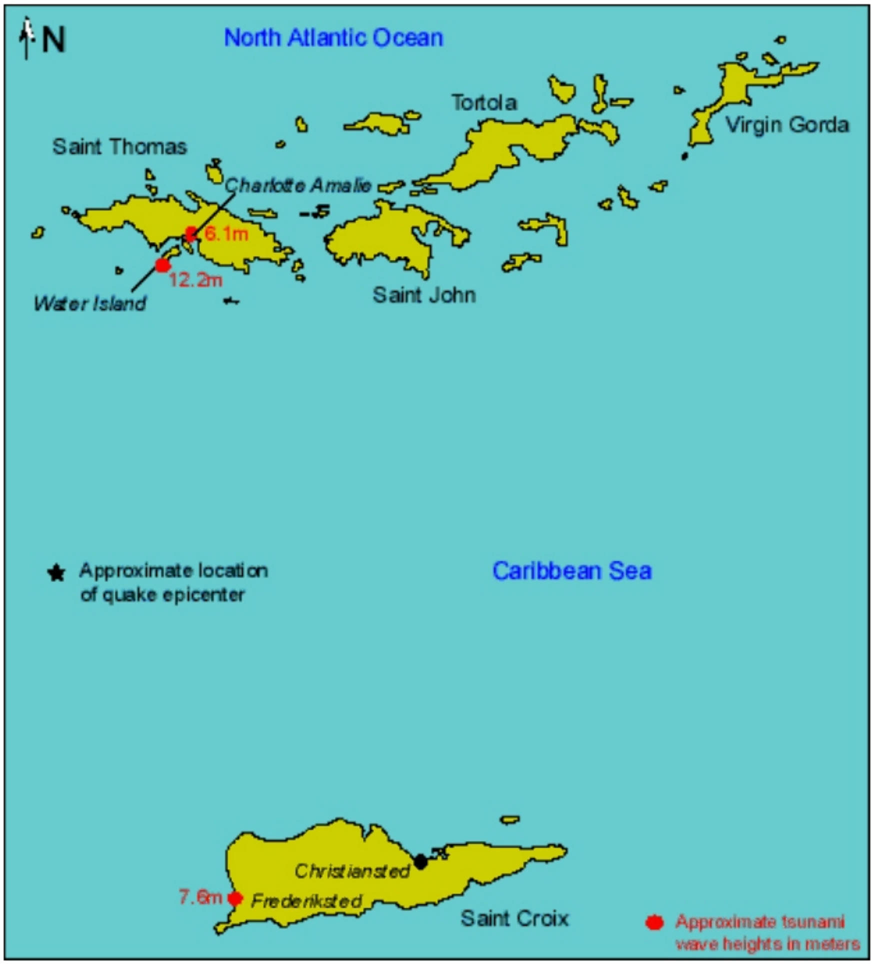
However, in 2000, the University of Puerto Rico established a tsunami warning system for both Puerto Rico and the U S Virgin Islands. The efforts to strengthen its reliability and effectiveness have increased, especially since the major event in the Pacific Basin in 2004 that affected Indonesia, W Thailand, Sri Lanka, SE India. The warning system has an estimated response time of twenty minutes after an earthquake event. But the close proximity of the Puerto Rican Trench and the Anegada Fault, a devastating tsunami could occur before warning is issued. Researchers estimate that should a strong tsunami occur in the northern Caribbean region, the increase in population within the potentially affected zone, 35,5 million people could be affected by such an event.

Tsunamis had a dramatic impact on the US Virgin Islands, when in 1867, a magnitude 7.5 earthquake occurred in the Anegada Trench. Two tsunami waves struck Charlotte Amalie, ten minutes apart. Both waves struck the harbor as a large recession of water, followed by a bore, which eyewitness accounts

describe as a 6 meter wall of water. The waves destroyed many boats anchored in the harbor, leveled the town's iron wharf, and either flooded out or destroyed all buildings located along the waterfront area. The tsunami produced an estimated 2.4 meters of run-up at Charlotte Amalie, and a maximum 75 meters of landward inundation. Frederiksted, in St. Croix was also stuck by two tsunami waves, that same day, although of lesser magnitude, estimated at 7.6 meters high.

Figure 4.20 illustrates the projected epicenter of the 1867 earthquake in relation to St. Thomas and St. Croix.

**FIGURE 4.20** ***Projected Epicenter of the 1867 Earthquake***




## Hazard Location, Extent and Distribution

Tsunami hazard areas are all low lying, relatively flat coastal areas. Tsunami hazard areas in US Virgin Islands are depicted in Figures 4.21, 4.22 and 4.23. Tsunami impacts will vary in the Virgin Islands. The Tsunami hazard maps have been updated for this Plan Update to be more conservative. They have been developed in accordance national tsunami evacuation planning mapping documentation. The maps have been developed to define an evacuation zone for the US Virgin Island using an 82-foot elevation profile and

an inundation of 2 miles from the coast. This evacuation criterion was based on historical events, tsunami modeling results from Puerto Rico and the BVI and the US National Tsunami Hazard Mitigation Program guidelines. This conservative estimate, however, did not consider offshore and near shore coastal topography (not considered in the tsunami hazard map developed in this study), vegetation and level and type of development. High waves will have only a serious impact, however, if the shoreline is low enough to be susceptible to flooding.

On St. Thomas, like St. John, the coastal areas are intensively developed. Charlotte Amalie and Cruz Bay are urbanized and have extensive infrastructure and road networks and are considered the most vulnerable areas to the tsunami hazard. On St. John, waterfront development, particularly port facilities and commercial development on the water such as shopping centers and hotels along the coastline could be affected by a tsunami. Both islands have secondary locations, Red Hook on St. Thomas and Coral Bay on St. John that are vulnerable to a tsunami. Both of these locations have experienced significant development in the past three years creating a potential for considerable property damage and possible loss of life.

In St. Thomas, cruise ships are highly vulnerable to tsunamis. In a recent paper given to the NSF Caribbean Tsunami Workshop, San Juan, March 30-31, 2004, Dr. Roy A. Watlington of the University of the Virgin Islands, indicated that on a three cruise ship day in St. Thomas, between 8:00 and 10:00 am as many as 12,000 tourists and crew may disembark to engage in recreational activities. The preferred activities of visitors, which include swimming at beaches, visits to the Coral World aquarium, sailing and boat sightseeing, keep them confined to tsunami prone coastal areas. Since the business district of Charlotte Amaile is also exposed to a tsunami, those visitors who elect to frequent the many stores, are also at risk. Furthermore, the report cites that several critical facilities are prone to tsunamis. These facilities include Virgin Islands Government offices (legislature, courts, and executive offices), electricity/desalination plants of the Water and Power Authority, the airport, port facilities and several schools.

The physiographic composition of St. Croix is vastly different from the previous two islands. The result is a landscape with much less topographic relief than St. Thomas and St. John. Nevertheless, it has two urban areas, Christiansted and Frederiksted that are particularly exposed to tsunami hazard. The town of Frederiksted suffered major damage from the 1867 tsunami, but not to the extent experienced on St. Thomas. Watlington, 1984 cites that on St. Croix several critical facilities are prone to tsunamis. These facilities include the electricity/desalination plant of the Water and Power Authority, HOVENSA (a large oil refinery), and the airport.

**FIGURE 4.21** ***Tsunami Hazard Map, St. Thomas***

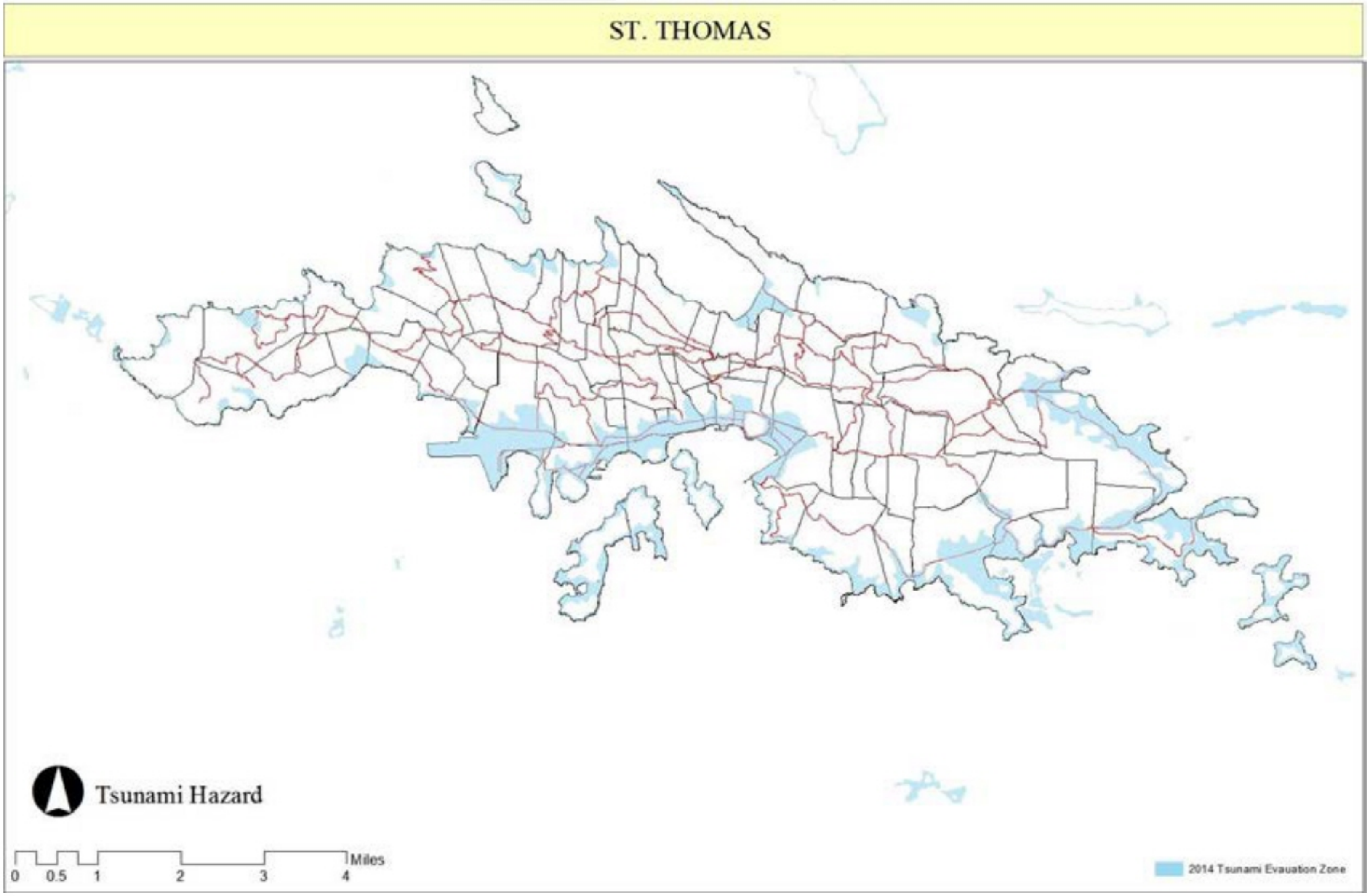
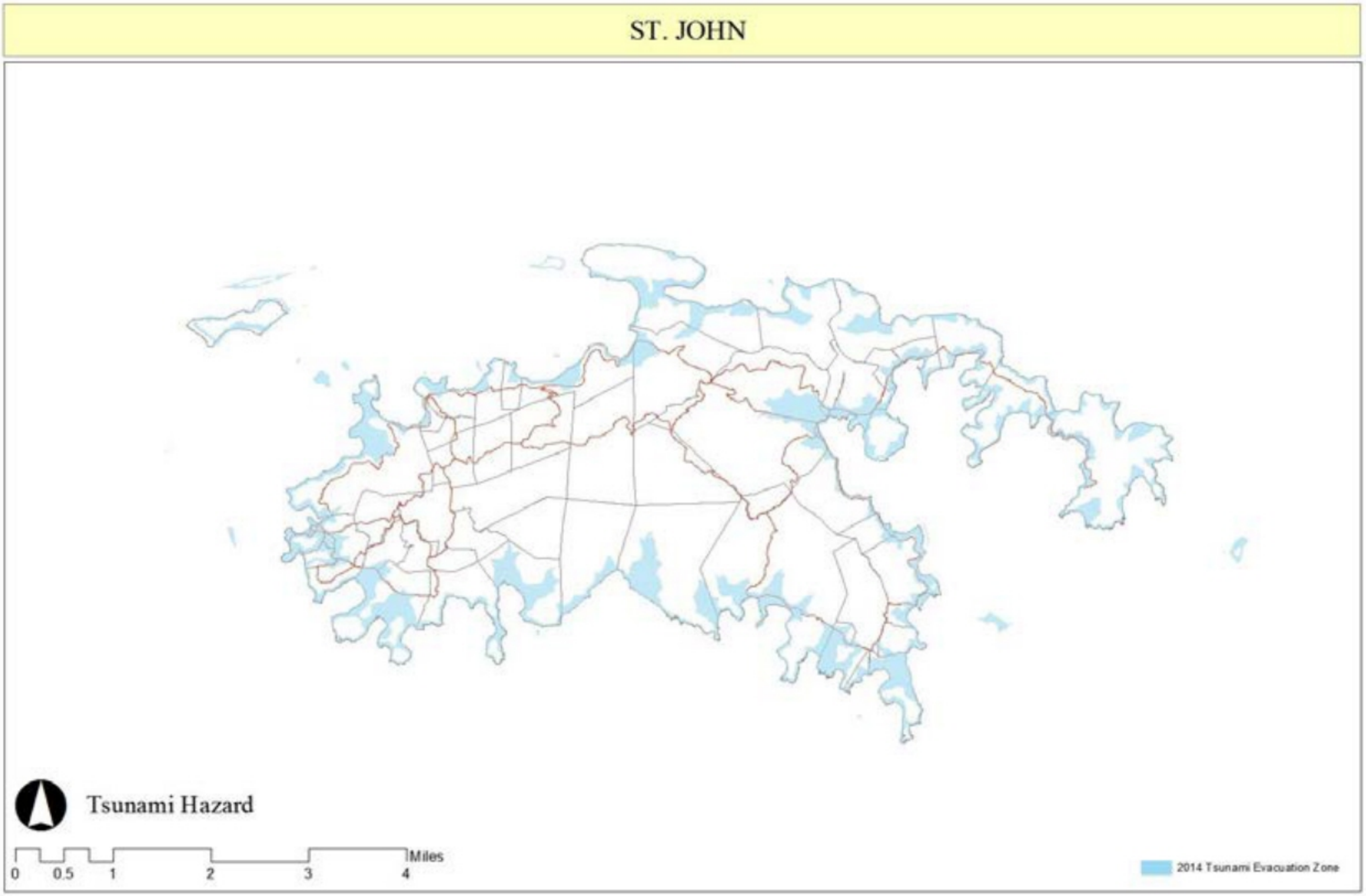


**FIGURE 4.22** ***Tsunami Hazard Map, St. Croix***

**FIGURE 4.23** ***Tsunami Hazard Map, St. John***



## Disaster History

Tom Parsons and Eric Geist[12] identify 116 individual observations of tsunami run ups in excess of 0.5 meters since 1530 (Caribbean-wide). Of these events, 14 tsunamis have been reported from Puerto Rico and the Virgin Islands (Lander et al., submitted). 30 tsunamis caused significant damage including reports of as many as 9,600 fatalities, which can be attributed to underwater earthquakes and tsunamis combined. 1,922 deaths are confirmed as being specifically related to tsunamis during the last 150 years. The following are events recorded for the Virgin Islands:

- May 7, 1842. Tsunami hit St. John. Maximum wave height was estimated to be 3 meters.
- Eyewitness reports of the 1868 St. Croix tsunami give a maximum wave height of over 20 feet in Frederiksted.
- A 1918 M 7.5 earthquake resulted in a tsunami that killed at least 116 people in northwestern Puerto Rico. A run up of about 20 feet has been documented by mapping, and sedimentary evidence for at least two earlier tsunamis in the area has been cited.

## Hazard Frequency and Magnitude

In crude terms, based on a record of approximately 100 recorded tsunamis in the Caribbean over the last 500 years, on average, one tsunami should be expected somewhere in the basin every 5 years. Conversely, Tom Parsons and Eric Geist, in a regional tsunami probability study conducted in 2009 estimate that the 30-year probability of a tsunami with runs up greater than or equal to 0.5 m at Charlotte Amalie is 18%. This combines the probability estimate from the historic catalog with numerical modeling results. The numerical model is based on a coarse grid and not geographically specific, but provides a good indicator of hazard frequency and magnitude.

## Data Sources, Models and Methodologies

**<u>Tsunami</u>**

- Based on oral communication with Tsunami hazard expert, Professor Roy Watlington, UVI
- USGS U.S. Geological Survey, "Earthquakes and Tsunamis in Puerto Rico and the U.S. Virgin Islands", Fact Sheet FS–141–00, 2001
- University of California Tsunami Research Group (http://www.usc.edu/dept/tsunamis/)
- Parson, T and Geist, E (2009): Pure and Applied Geophysics, Vol. 165, 2089-2116
- Guidelines and Best Practices to Establish Areas of Tsunami Inundation for Non-modeled or Low-hazard Regions" (see http://nthmp.tsunami.gov/modeling_guidelines.html).

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[12] Database of Caribbean Tsunami observations with runup ≥0.5 meters. Sources NOAA n-line database and Lander 2003.

- Preparing Your Community for Tsunamis – A Guidebook for Local Advocates, Version 2.1, February 1, 2008, Laura Dwelley Samant, L. Thomas Tobin, Brian Tucker (http://www.preventionweb.net/files/3984_PreparingYourCommunityforTsunamisV21.pdf).

**Tsunami Hazard Assessment and Determination**

- The tsunami hazard maps used in this study were developed based on estimates of a historical event, the tsunami of 1867. The estimated maximum wave height of the tsunami of 1867 was 7 meters.
- Wave height estimates were intersected with a digital elevation model to develop tsunami inundation maps. These maps are based on a historical tsunami scenario and expert interviews. Inundation maps may have no significant bearing on any actual tsunami event and should not be used during a real tsunami event.
- GIS overlay techniques were utilized to identify structures in the inundation areas. Flood depths were not estimated.
- Database of Caribbean Tsunami observations with run up ≥0.5 meters. Sources NOAA n-line database and Lander 2003.

**Inventory Data (Assets)**

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

## 4.4.9 WILDFIRE

### Hazard Description

A wildfire is an undesirable, uncontrolled burning of grasslands, brush or woodlands. According to the National Weather Service, more than 100,000 wildfires occur in the United States each year. About 90% of these wildfires are started by humans (i.e., campfires, debris burning, smoking, etc.); the other 10% are started by lightning. Wildfires, by definition, occur in areas where development is sparse and as a result often begin unnoticed and spread quickly.

The potential for wildfire depends upon surface fuel characteristics, weather conditions, recent climate conditions, topography and fire behavior. Fuels are defined as anything that fire can and will burn, and are the combustible materials that sustain a wildfire. Typically, this is the most prevalent vegetation in a given area. Weather is one of the most significant factors in determining the severity of wildfires. The intensity of fires and the rate with which they spread is directly rated to the wind speed, temperature and relative humidity. Climatic conditions such as long-term drought also play a major role in the number and intensity of wildfires, and topography is important because the slope and shape of the terrain can change the rate of speed at which fire travels.

There are four major types of wildfires, they are:

- Ground fires burn in natural litter, duff, roots or sometimes even highly-organic soils. Once started they are very difficult to control, and some ground fires may even rekindle after being extinguished.

- Surface fires burn in grasses and low shrubs (up to 4' tall) or in the lower branches of trees. They have the potential to spread rapidly, and the ease of their control depends upon the fuel involved.

- Crown fires burn in the tops of trees, and the ease of their control depends greatly upon wind conditions.

- Spotting fires occur when burning embers are thrown ahead of the main fire, and can be produced by crown fires as well as wind and topographic conditions. Once spotting fires begin, the fire will be very difficult to control.

## Nature of the Hazard

In the US Virgin Islands, the pattern of development in which structures are mixed in with or next to flammable vegetation, increases the territory's susceptibility to wildfires. The US Virgin Islands is considered to have a mixed wild land/urban interface where structures and other human development meet or intermingle with undeveloped vegetative lands.

On the islands of St. Thomas and St. John the wild land/urban intersection usually occurs in areas where homes developed are in steep vegetated areas. Furthermore, access to these areas is made difficult by the steep and narrow roadways. On St. Croix, residential and commercial structures are intermingled with grasslands and/or scrublands. Many of the wildfires on St. Croix tend to be caused by persons burning garbage or clearing their land for cultivation. These wildfires tend to occur in the dry season and spread for hundreds of areas across sparsely populated lands.

## Hazard Location, Extent and Distribution

Because high-resolution data was not readily available to accurately identify the degree of wildfire hazard throughout the US Virgin Islands, a precise analysis to determine the geographic extent for the wildfire hazard could not be performed. Instead an approximate analysis mapping was utilized to identify general areas throughout the islands that could be prone to Wildfire (See Figures 4.24, 4.25 and 4.26).

It is necessary to note that historically fires have been man-caused, and limited primarily to St. Croix, and have spread over hundreds of acres.

**FIGURE 4.24** ***Wildfire Hazard Map, St. Thomas***

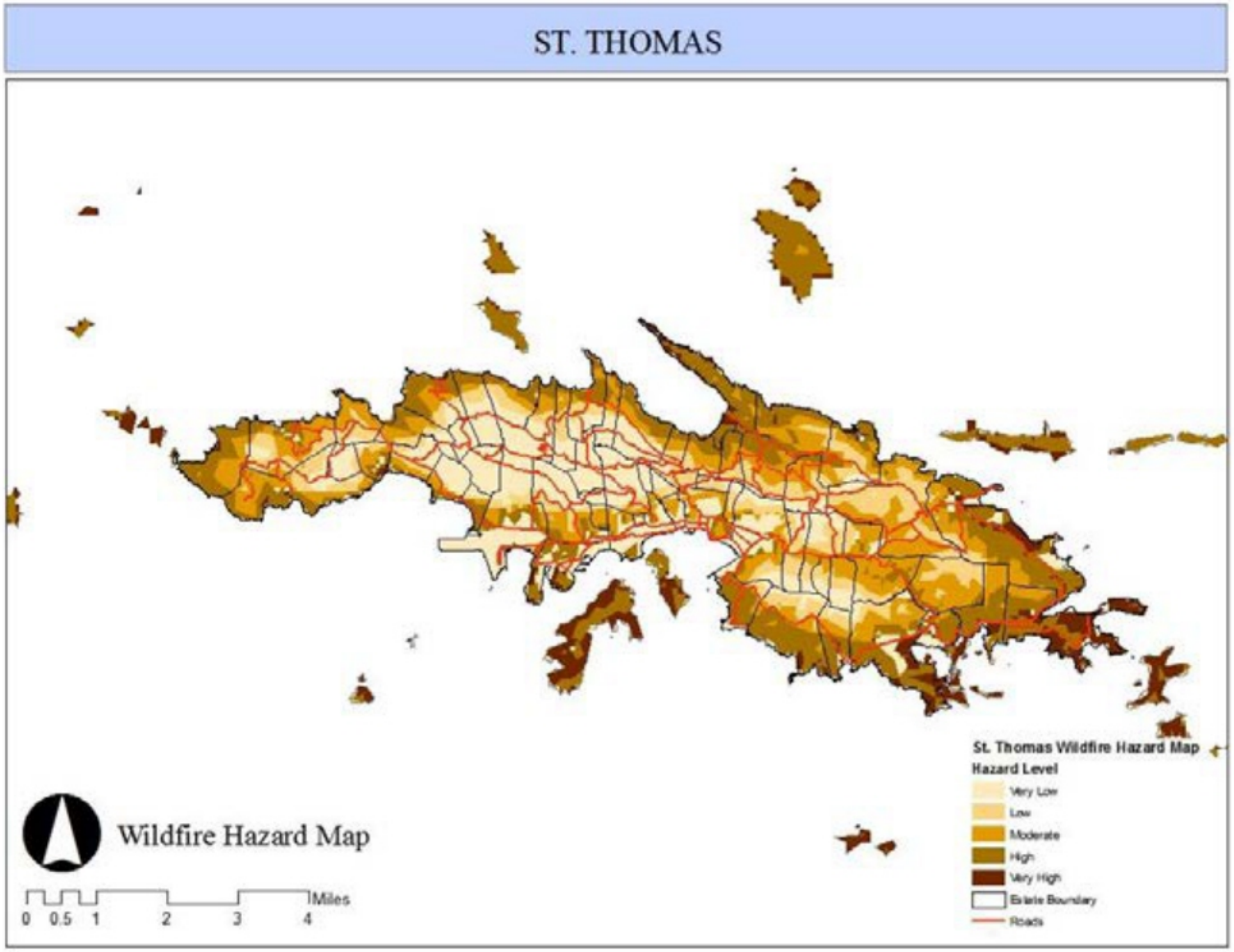


**FIGURE 4.25** ***Wildfire Hazard Map, St. Croix***

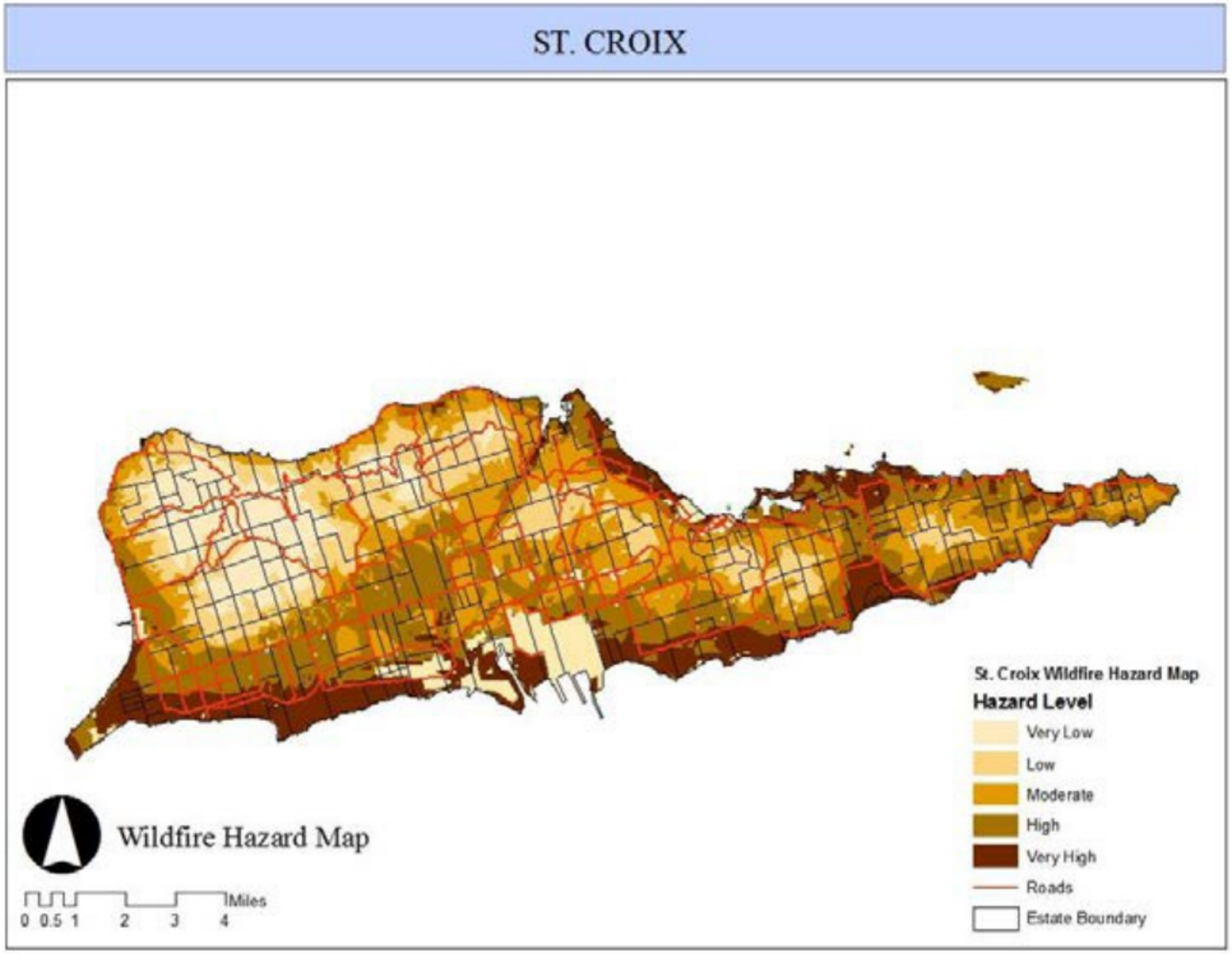
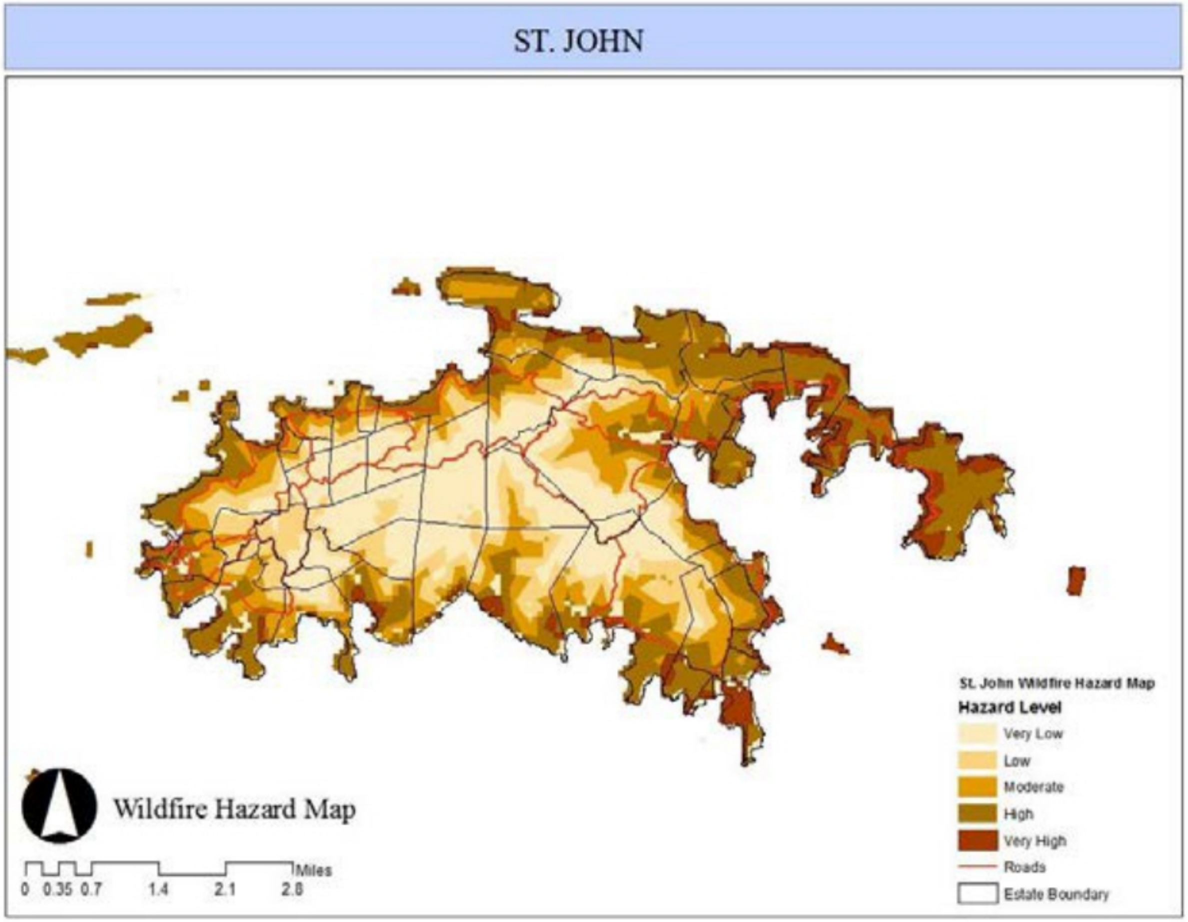


**FIGURE 4.26** ***Wildfire Hazard Map, St. John***



## Disaster History

The National Climatic Data Center record indicates that there have been only 18 confirmed wild/forest fires in the Territory between 2000 and 2010. All of these events were reported on St. Croix. Below are descriptions taken from the National Climatic Data Center (NOAA's on-line database):

1. April 14, 2000: Approximately 100 acres were burnt by brush fires fueled by dry, windy conditions in St. Croix western end hillsides. The fires began in Calqouhoun and spread to cover a broad area in William's Delight, Queen Louise and Estate Mountain. No homes were destroyed and nobody was injured.

2. March 13, 2000. Brush fires affected about 600 acres of land in Lowry Hill and Tide Village in East End. No damage was reported to homes, structures and nobody was injured. The cause of fire was unknown but arson was suspected.

3. March 18, 2001. Brush fires affected about 100 acres near Mount Welcome and Recovery Hill. No damages were reported on structures, homes or people. The suspected cause of the fire was an abandoned car that someone set afire.

4. March 29, 2001. A brush fire formed at Kingshill Area across the Centerline Road. The fire affected a nearby elementary school with smoke. Four students were taken to the Hospital with respiratory difficulties. All of them were unharmed.

5. April 2, 2001.Brush fires affected about 215 acres of land in Recovery Welcome, Peter's Farm and a section just east of Gallows Bay. No damages were reported on homes, structure or affected any people. The cause of these fires was unknown, but arson was suspected in Gallows Bay.

6. March 13, 2003. Brush fires fueled by strong winds scorched hundreds of acres on St Croix, at Estates Bethlehem, Calguohoun, Cobble, and Lowry Hill. The extremely dry conditions appeared to have spawned multiple fires. Several telephone poles were damaged, and some livestock may have perished. About 60 acres of pasture and brush were lost in Estate Lowry Hill.

7. April 3, 2003. A brush fire was reported near Grassy Point in St Croix. It was burning up in open terrain and hills. A substantial number of acres were burned. Lack of rainfall could have been a contributing factor.

8. March 4, 2005. A brush fire scorched more than 300 acres of vegetation near South Sore cafe in Estate Petronelli. Several utility poles were damaged.

9. March 8, 2005. More than 15 acres of brush was scorched when a fire crept over an open field between Estates Mon Bijou and Calquohoun.

10. March 11, 2011. A brush fire on the east end of the island consumed more than one 100 acres of parched vegetation near Grape Tree Bay. The fire damaged several utility poles.

11. March 13, 2005. Brush fires fueled by brisk winds scorched hundreds of acres on St. Croix. Fires were in estates Bethlehem, Calquohoun and Cobble. The fire damaged several telephone poles and some livestock could have perished.

12. April 13, 2005. Two brush fires developed on the west end of St. Croix, in a field next to Williams's Delight. Morev than 40 acres burned.

13. April 21, 2005. A massive brush fire was reported on the East End. The fire erupted near Tide Village and quickly spread to hillsides surrounding Lowry Hill and Estate Boetzberg. The fire consumed more than 200 acres of hillside and pastureland.

14. March 8, 2007. A large brush fire burnt more than 800 acres near Castle Nugent, Lowry Hill and Estate Sight on Saint Croix's East End.

15. March 14, 2007. A brush fire scorched four acres of grassland near Ha'Penny on the island's south shore.

16. March 19, 2007. A brush fire scorched more than 100 acres in an open field in Estate Concordia east of Frederiksted.

17. March 28, 2007. A brush fire scorched 40 acres at Estate Granard.

18. April 14, 2010. A brush fire broke out on Saint Croix's south shore to the west of Howard Wall Boy Scouts facility. More than 50 acres of pasture and dry vegetation were consumed.

## Climate Variability, Hazard Frequency and Magnitude

The historic average occurrence of wildfires in the US Virgin Islands serves as the best value for predicting future expected recurrence. Based on the limited data, US Virgin Islands can expect at least one (1) wildfire event per year. Such predictions are limited by the number of years for which data was available and the recorded damages per event. Therefore, a thorough understanding of magnitude of wildfire events is very limited.

It is important to note that IPPC and PRECIS climate change models predict that temperatures will increase. Taylor et al. (2007) on the basis of the first round of PRECIS simulations driven by the HadAM3P GCM, have shown that the Caribbean is 1°- 5°C warmer in the annual mean by the

2080s (a 30-yr period from 2071 to 2100), and one also characterized by a greater warming in the northwest (Jamaica, Cuba, Hispaniola, and Belize) in comparison to the eastern Caribbean islands, which includes the Virgin Islands. They also predict a greater warming in the summer months than in the drier early months of the year (Taylor, M. A., and Coauthors, 2007).

This combined with the expected incidence of drought provides a clear indication that the occurrence of wildfire events is likely to increase in the future due to climate change.

## 4.5 INVENTORY OF ASSETS

For the Plan Update, VITEMA utilized a methodology that was consistent with FEMA Publication 386-2, "State and Local Mitigation Planning How-To Guide, Understanding Your Risks—Identifying Hazards and Estimating Losses" (FEMA 2001). This methodology is the same that was utilized for the development of the 2011 Plan. It includes:

- Estimate or count the total number of buildings, value of buildings, and population in your community.
- Determine the proportion of buildings, the value of buildings, and the population in your community or state that are located in hazard areas, and
- Calculate the proportion of assets located in hazard areas.

### 4.5.1 INVENTORY DATA COLLECTION

Specific assets evaluated for this Plan Update include population, buildings, and critical facilities, including infrastructure. General inventory information was collected from the Office of the Lieutenant Governor's Tax Assessors Office and was used to classify the general building stock. Site specific data was also gathered from VITEMA and the Department of Property and Procurement and used to classify critical facilities and infrastructure. The data utilized in this Plan was aggregated from the fiscal cadastral (tax values) derived from the Lieutenant Governor's Tax Assessors Office. Plans and contain estimates of the price and quantities of structures used for residential and commercial purposes in the U.S. Virgin Islands. The aggregation of data and all estimates of structure costs used actual prices for commercial and residential structures, which were derived from the Office of the Lieutenant Governor's Tax Assessors Office. Update of critical facility information was derived from annual data sets were derived from publicly available data from the Bureau of Economic Analysis (BEA).

Detailed spatial and non-spatial local data were gathered, compiled, and analyzed in a Geographic Information System (GIS). These data are discussed below under the following categories:

- General Building Stock
- Critical Facilities and Infrastructure

### General Building Stock

Local tax assessor information was used to develop a detailed inventory of the built environment in the US Virgin Islands. Specifically, the Virgin Islands Tax Assessors Office (Division of the office of the Lt. Governor), provided their parcel maps and property tax valuation database. The database has been updated and was reevaluated. The OLG data was found to be consistent with tax lot information and could be used to identify use of parcel and/or building.

Since the 2011 Plan Update, the Virgin Islands Tax Assessors Office (Division of the office of the Lt. Governor), have made revisions to the property valuations throughout the entire Territory of the Virgin Islands. This revised database was not made available to VITEMA, and as a result, the same database that was utilized during the 2011 Update was utilized to categorize the built environment.

The OLG database; however, had certain limitations related to structure classification and only classified building by general usage. Field surveys were eliminated from the budget and not conducted during this Plan Update. The field investigations that were conducted during the 2005 and 2008 Plan Updates were deemed to be satisfactory to determine the distribution of different building types and to gather structural information for each occupancy class.

In this Update, and in order to conduct basic analyses and gather information that would be useful to determine general loss estimates, structural categories remained the same as in the 2011 Plan Update. The ten (10) model building types remain consistent with field investigations conducted during this Plan Update, these include:

- Low Rise Wood Frame Dwelling,
- Mid-rise Wood Frame Dwelling,
- Low Rise Reinforced Concrete Dwelling,
- Mid Rise Reinforced Concrete Dwelling,
- Low Rise Steel Building,
- Mid Rise Steel Building,
- Low Rise Un-reinforced Masonry Building,
- Mid Rise Un-reinforced Masonry Building,
- Low Rise Reinforced Masonry Building, and
- Mid Rise Reinforced Masonry Building

The distribution of particular building types for each estate boundary for each island was then updated. This facilitated an understanding of the distribution of model building types for a specific occupancy class, at the estate level, for each island. It is necessary to note, however, that based on a rapid inspection of buildings that steel frame buildings a becoming more prevalent for larger institutional buildings.

This analysis provided a basis to estimate the total number of buildings and to aggregate replacement and content values for model building types.

## Territorial Facilities and Infrastructure

There were not any changes made to the critical facility listing from the last plan. The listing of critical facilities provided by VITEMA was crossed checked with the listing of facilities included in the 2011 plan. Facilities such as schools, police and fire stations, and hospitals, are known as “critical facilities.” Infrastructure is separated into two distinct classes that have substantially

different damage and loss characteristics: (1) transportation systems (key roads, ports, airports) and (2) utility infrastructure (electric power stations, potable water treatment plants, wastewater treatment plants, water pumps). The following three-part definition of critical facilities and infrastructure shall apply:

Critical Facilities

Critical facilities are those facilities that provide services to the community and should be functional after a hazard event. They include:

- Government buildings necessary for continuity of operations,
- Hospitals,
- Police stations,
- Fire stations,
- Schools, and
- Homes for the ageing.

Transportation Infrastructure

Transportation Infrastructures are facilities that enable the movement of goods, particularly emergency relief supplies. They include:

- Marine Facilities, and
- Airports.

Utilities and Infrastructure

Utilities and Infrastructure are facilities that, if damaged, could have far-reaching consequences for the environment. They include:

- Electrical Power Generating Plants,
- Water Treatment Plants,
- Wastewater Treatment Plants,
- Potable Water Pumps, and
- Water Tanks.

This list of facilities was provided by VITEMA for this Plan Update. No new data was provided by Department of Property and Procurement for this plan Update, despite several requests being made by the contractor and VITEMA. Therefore, it was determined that a detailed site inspection was not required during this plan update. Instead, information gathered from VITEMA was used to update inventory information.

The 2014 Plan has categorized facilities and infrastructure by their structural characteristics relevant to vulnerability to the prominent hazards identified in the study. In this Plan, like the 2011 Plan, replacement and content values for facilities were determined using the FEMA guideline of

content value as a percentage of building replacement value. In the 2014 Plan Update, facility values were updated utilizing a compounded inflation factor for the three year period.

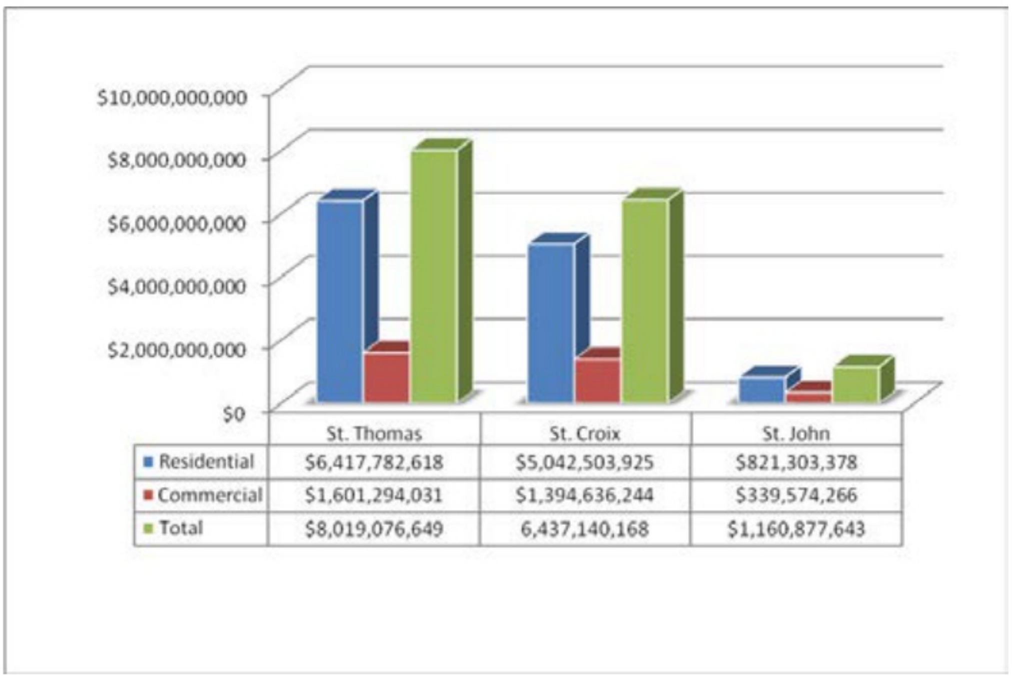
## 4.5.2 EXPOSURE VALUES

Exposure, as applied in this section of the Plan Update, means, the total amount of property value that are vulnerable to severe loss in the occurrence of a natural hazard event. Exposure is used to quantify the potential financial loss in the event of a natural hazard. Values shown include average building values, structural values (replacement costs), "content value," and total value.

### General Building Stock

Figure 4.25 shows the average estimated value of individual buildings by occupancy class. Exposure values are based on data gathered at the Office of Lieutenant Governor's office and field investigations. The total inventory value for residential and commercial buildings is $16 billion, which represents an increase of approximately a $2 billion dollars since 2011.

**FIGURE 4.25** ***Building Stock Values by Occupancy Class for US Virgin Islands***




| | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| Residential | $6,417,782,618 | $5,042,503,925 | $821,303,378 |
| Commercial | $1,601,294,031 | $1,394,636,244 | $339,574,266 |
| Total | $8,019,076,649 | 6,437,140,168 | $1,160,877,643 |

Table 4.9 presents the estimated number of buildings and their dollar value by occupancy class, for each island in the Territory.

**TABLE 4.10** ***Inventory of General Building Stock***[13]

| Building Occupancy Class | Estimated Number of Buildings 2014 | Estimated Aggregate Replacement Cost | Estimated Aggregate Content Value | Total Value |
|---|---|---|---|---|
| | | | | |
| **St. Thomas** | | | | |
| Residential | 23,365 | $ 4,281,518,328.05 | $ 2,136,264,289.84 | $ 6,417,782,617.89 |
| Commercial | 998 | $ 800,647,015.35 | $ 800,647,015.35 | $ 1,601,294,030.70 |
| **Total** | 24,362 | $ 5,082,165,343.40 | $ 2,936,911,305.19 | $ 8,019,076,648.59 |
| | | | | |
| **St. Croix** | | | | |
| Residential | 22,569 | $ 4,345,185,802.97 | $ 697,318,121.83 | $ 5,042,503,924.80 |
| Commercial | 841 | $ 697,318,121.83 | $ 697,318,121.83 | $ 1,394,636,243.67 |
| **Total** | 23,410 | $ 5,042,503,924.80 | $ 1,394,636,243.67 | $ 6,437,140,168.47 |
| | | | | |
| **St. John** | 0 | | | |
| Residential | 2,230 | $ 549,521,425.04 | $ 271,781,952.46 | $ 821,303,377.50 |
| Commercial | 82 | $ 271,781,952.46 | $ 67,792,313.19 | $ 339,574,265.65 |
| **Total** | 2,328 | $ 821,303,377.50 | $ 339,574,265.65 | $ 1,160,877,643.15 |

For this Plan Update (2014), an in-depth analysis of building stock was not undertaken, but it is a fair assessment that the US Virgin Islands has been affected by the same housing downturn that has affected the US mainland. Values as reflected by inflation multipliers have remained stable in the Territory with St. John receiving the most new construction activity of all three islands. St. Croix, however, has suffered due to the closure of the HOVENSA refinery and has experienced only a modest increase in value of residential and commercial structures as opposed to the 15% increase experienced on St. Thomas and St. John.

## Territorial Facilities and Infrastructure

Table 4.11 shows the estimated value of critical facilities and infrastructure in primary categories. Precise valuation information was not readily available from VITEMA or Department of Property and Procurement at the time of the Plan Update; therefore, the values presented in the section are a close approximation of the actual value of these important structures. The valuation of these facilities for this Update was based on the estimated area of the structures and an inflation factor of

[13] Single family dwellings are a subset of the total residential occupancy class. Total values include the sum of residential and commercial occupancy classes.

1.21 for the three year period. This inflation factor was developed through data supplied by the U.S. Department of Commerce, Bureau of Economic Analysis.

**TABLE 4.11** ***Estimated Value of Critical Facilities and Infrastructure***

| Facility | St. Thomas | | St. Croix | | St. John | |
|---|---|---|---|---|---|---|
| | # of Facilities in Class | Total Exposure | # of Facilities in Class | Total Exposure | # of Facilities in Class | Total Exposure |
| **Critical Facilities** | | | | | | |
| Police Stations | 5 | 12,727,552 | 6 | 63,719,946 | 2 | 4,321,296 |
| Fire Stations | 5 | 7,792,547 | 5 | 9,269,808 | 2 | 4,845,666 |
| Emergency Response | 1 | 6,472,875 | | - | 1 | 5,142,339 |
| Hospital/ Medical Clinic | 5 | 95,838,253 | 3 | 135,990,389 | 2 | 17,590,586 |
| Government Buildings | 11 | 118,417,923 | 12 | 121,046,648 | 3 | 13,159,486 |
| Shelters | 8 | 123,556,219 | 11 | 173,286,506 | 5 | 52,473,202 |
| **Transportation Infrastructure** | | | | | | |
| Marine Ports | 4 | 26,038,712 | 5 | 9,922,078 | 1 | 2,884,325 |
| Airport | 1 | 22,475,260 | 1 | 57,686,500 | N/A | |
| **Utilities** | | | | | | |
| Electrical Power Generating Plants | 1 | 51,172,046 | 1 | 51,917,850 | 1 | 15,575,355 |
| Water Treatment Plants<br>Wastewater Treatment Plants<br>Potable Water Pumps<br>Water Tanks | 5 | 61,792,356 | 36 | 110,067,300 | 4 | 33,518,154 |

## 4.6 VULNERABILITY ASSESSMENT

This section of the Plan Update facilitates an understanding of the proportion of buildings, the value of buildings, and the population located in hazard areas. VITEMA utilized information from the Hazard Identification and Profile information (i.e. wind speed, flood depth, etc.) to assess the vulnerability parameters (specific damage and loss characteristics) of each asset identified.

Vulnerable subgroups of the population for each island were determined using the Census 2010 data. For this Plan Update, population projections for 2014 were prepared accounting for annual growth rate of roughly -.56% (CIA Fact Book). This is lower than growth rate that was utilized in the 2011 Plan Update and is considerably lower than the estimated growth rate for the period 2000-2010. The annual growth rate was applied for four years 2010 to 2014, to estimate population for 2014.

Once the population was projected, the vulnerability analysis looked first at social impacts. The social analysis identified the number of people less than 18 years of age and the number of people over 65 years of age. These two demographic subgroups help define the territory's social vulnerability as they are the most likely to need assistance during and/or after a hazard event. A series of GIS hazard overlay queries were performed to indicate where the people reside within the territory relative to hazards.

Following, the vulnerability assessment was used to estimate potential losses to each hazard. The estimation of how many buildings that are susceptible to hazard related damage are based on either the location of buildings to a particular hazard (i.e. flood zone, earthquake ground shaking level) or based on hazard intensity expressed across each of the Territory's major islands (i.e. wind speed). The pursuant tables identify the number of buildings and value that are exposed to a certain level of hazard intensity. The extent and severity of damage to structural and nonstructural components of a building is described by one of five damage states**:**

- Very Low, (no, or negligible damage)
- Low, (easily repairable damage mainly to part of nonstructural components and/or contents)
- Moderate, (considerable, yet repairable damage to mainly non-structural components)
- High (considerable damage to both structural and non-structural components), and
- Very High (that the extent of damage is too much to be repaired; the facility has to be demolished and replaced).

The qualitative vulnerability ratings relate to a percentage of damage for each model building type across each island. The damage estimation methods for critical facilities and infrastructure are identical to those utilized to estimate damage with general building stock, except that classification or grouping of facilities was not needed and performed on a structure by structure basis.

## 4.6.1 DROUGHT

This section discusses the population and the proportion and value of buildings located in areas affected by a drought. It also provides an estimate of proportion of assets located in areas that are susceptible to drought.

### Social Impacts

Table 4.12 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.12** ***Social Impacts (Drought)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 8,876 | 16% | 2,187 | 4% |
| | | | | | |
| St. Croix | 56,404 | 8,271 | 15% | 2,037 | 4% |
| | | | | | |
| St. John | 4,447 | 925 | 21% | 228 | 5% |

### Physical and Economic Impacts

- In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings that are susceptible to a hazard. The findings of the vulnerability assessment for this Plan Update indicate that there are 11,215 residential structures exposed to this hazard on St. Thomas and 787 commercial structures. On St. Croix, there are 9,458 residential structures and 192 commercial structures exposed to this hazard, while on St. John the total number of residential properties exposed is 1371and 11 commercial structures.

- On St. Thomas, approximately 48% percent of the residential building stock and 36% of the commercial building stock is considered to be vulnerable to drought. Of this percentage, approximately 26% of the residential building stock is of high vulnerability and the remaining 22% is of very high vulnerability to a drought event. Commercial structures are not considered to be vulnerable to drought events with 35% of the commercial stock

being exposed to the hazard, none of which are classified as very high.

- On St. Croix, approximately 43% percent of the residential building stock and 23% of the commercial building stock is considered to be vulnerable to drought. Of this percentage, approximately 34% of the residential building stock is of medium vulnerability, 15% of the residential building stock is of high vulnerability, and the remaining 28% is of very high vulnerability to drought. None of the commercial building inventory is of medium vulnerability, none has high or very high vulnerability rating to a drought event.

- On St. John, approximately 61% percent of the residential building stock and 14% of the commercial building stock is considered to be vulnerable to a drought hazard. Of this percentage, approximately 26% of the residential building stock is of medium vulnerability, 28% of the residential building stock is of high vulnerability, and the remaining 33% is of very high vulnerability to a drought event. None of the commercial building inventory is of medium vulnerability, none has high or very high vulnerability rating to a drought event.

The tables below show potential dollar exposure to drought hazard on St. Thomas, St. Croix and St. John.

**TABLE 4.13 *Estimated Drought Exposure and Vulnerability (St. Thomas)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 48% | 13% | 23% | 16% | 26% | 22% |
| No. of Residential | 11,215 | 1,404 | 5,262 | 3,836 | 6,148 | 5,193 |
| Value of Residential | $3,085,163,402 | $386,351,477 | $694,754,849 | $506,474,402 | $811,865,287 | $685,717,387 |
| | | | | | | |
| % of Commercial | 36% | 36% | 64% | 0 | 0 | 0 |
| No. of Commercial | 787 | 284 | 503 | 0 | 0 | 0 |
| Value of Commercial | $655,447,244 | $236,689,283 | $418,757,961 | $0.00 | $0.00 | $0.00 |

**TABLE 4.14** ***Estimated Drought Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 43% | 9% | 14% | 34% | 15% | 28% |
| No. of Residential | 9458 | 822 | 117 | 39 | 6 | 2 |
| Value of Residential | $2,492,165,251 | 216,673,928 | 30,756,222 | 10,393,800 | 1,583,133 | 444,630 |
| | | | | | | |
| % of Commercial | 23% | 41% | 61% | 0 | 0 | 0 |
| No. of Commercial | 192 | 79 | 48 | 0 | 0 | 0 |
| Value of Commercial | $331,528,001 | 135,625,091 | 82,554,403 | 0 | 0 | 0 |

**TABLE 4.15** ***Estimated Drought Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 61% | 2% | 12% | 26% | 28% | 33% |
| No. of Residential | 1371 | 24 | 164 | 352 | 385 | 446 |
| Value of Residential | $500,995,060 | 8,631,645 | 59,792,124 | 128,575,545 | 140,893,622 | 163,102,125 |
| | | | | | | |
| % of Commercial | 14% | 14% | 86% | 0% | 0% | 0% |
| No. of Commercial | 11 | 2 | 10 | 0 | 0 | 0 |
| Value of Commercial | $47,540,397 | 6,791,485 | 40,748,912 | 0 | 0 | 0 |

## Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

**TABLE 4.16** ***Estimated Drought Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| **Critical Facilities** | | | | | | | |
| Police Stations | 5 | 2 | | | 2 | 1 | 12,727,552 |
| Fire Stations | 5 | 3 | 2 | | | | 7,792,547 |
| Emergency Response | 1 | | | | | 1 | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | 4 | | 1 | | | 95,838,253 |
| Government Buildings | 11 | 9 | | 9 | 9 | | 118,417,923 |
| Shelters | 5 | 2 | 1 | | 1 | 1 | 123,556,219 |
| **Transportation Infrastructure** | | | | | | | |
| Marine Ports | 4 | 4 | | | | | 26,038,712 |
| Airport | 1 | 1 | | | | | 22,475,260 |
| **Utilities** | | | | | | | |
| Electrical Power Generating Plants | 1 | 1 | | | | | 51,172,046 |
| Sewage Treatment Plant | 1 | | | 1 | | | 61,792,356 |
| Water Treatment Plant | 1 | | 1 | | | | |
| WAPA Tanks | 1 | | | 1 | | | |
| Pumping Station | 1 | 1 | | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.17** ***Estimated Drought Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| **Critical Facilities** | | | | | | | |
| Police Stations | 6 | 3 | 2 | | 1 | | 63,719,946 |
| Fire Stations | 5 | 3 | | 2 | | | 9,269,808 |
| Emergency Response | N/A | | | | | | - |
| Hospital/ Medical Clinic | 3 | 3 | | | | | 135,990,389 |
| Government Buildings | 12 | 6 | | | 2 | 4 | 121,046,648 |
| Shelters/Special Needs | 11 | 3 | | | 5 | 3 | 173,286,506 |
| **Transportation Infrastructure** | | | | | | | |
| Marine Ports | 5 | 5 | | | | | 9,922,078 |
| Airport | 1 | 1 | | | | | 57,686,500 |
| **Utilities** | | | | | | | |
| Electrical Power Generating Plants | 1 | 1 | | | | | 51,917,850 |
| Sewage Pumps | 14 | 9 | | | | 5 | 110,067,300 |
| Wastewater Treatment Plant | 1 | 1 | | | | | |
| Water Treatment Plant | 1 | 1 | | | | | |
| Water Pumps | 8 | 1 | 4 | 3 | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.18** ***Estimated Drought Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| **Critical Facilities** | | | | | | | |
| Police Stations | 2 | 1 | | 1 | | 2 | 4,321,296 |
| Fire Stations | 2 | 1 | | | | | 4,845,666 |
| Emergency Response | 1 | | | | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | | | 1 | | 1 | 17,590,586 |
| Government Buildings | 3 | 3 | | | | | 13,159,486 |
| Shelters/Special Needs | 5 | 1 | | 2 | | 2 | 52,473,202 |
| **Transportation Infrastructure** | | | | | | | - |
| Marine Ports | 1 | 1 | | | | | 2,884,325 |
| Airport | N/A | | | | | | |
| **Utilities** | | | | | | | - |
| Electrical Power Generating Plants | 1 | 1 | | | | | 15,575,355 |
| WAPA Desalinization Plant | 1 | 1 | | | | | |
| WAPA Water Tank | 1 | 1 | | | | | |
| Sewage Treatment Plant | 1 | 1 | | | | | |
| Potable Water Tank | 1 | 1 | | | | | 33,518,154 |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

## 4.6.2 EARTHQUAKE

This section discusses the population and the proportion and value of buildings located in areas affected by an earthquake hazard. It also provides an estimate of proportion of assets located in earthquake hazard areas.

### Social Impacts

Table 4.30 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.19*Social Impacts (Earthquake)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 5,965 | 11% | 1,627 | 3% |
| | | | | | |
| St. Croix | 56,404 | 8,461 | 15% | 1,692 | 3% |
| | | | | | |
| St. John | 4,447 | 623 | 14% | 178 | 4% |

### Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 558 residential properties exposed to this hazard on St. Thomas. On St. Croix, there was an increase of 405 residential properties exposed to this hazard, while on St. John the total number of residential properties exposed increased by 41. On St. Thomas there were 55 additional commercial properties exposed to this hazard. In St. Croix there was an increase of 18 commercial properties exposed to this hazard. On St. John there were 2 less commercial properties exposed to this hazard.

- On St. Thomas approximately 91% percent of the residential building stock and 96% of the commercial building stock is considered to be vulnerable to an earthquake event. Of this percentage, approximately 42% of the residential building stock is of high vulnerability and the remaining 58% is of very high vulnerability to an earthquake event. About 20% of the commercial building inventory is of high vulnerability to an earthquake and the remaining 80% of the inventory has a very high vulnerability to a seismic event.

- On St. Croix approximately 70% percent of the residential building stock and 84% of the commercial building stock is considered to be vulnerable to an earthquake event. Of this percentage, approximately 75% of the residential building stock is of medium vulnerability, 5% of the residential building stock is of high vulnerability, and the remaining 20% is of very high vulnerability to an earthquake event. About 84% of the commercial building inventory is of medium vulnerability, none has high vulnerability, and the remaining 27% of the inventory has a very high vulnerability to a seismic event.

- On St. John approximately 71% percent of the residential building stock and 85% of the commercial building stock is considered to be vulnerable to an earthquake event. Of this percentage, approximately 71% of the residential building stock is of medium vulnerability, 11% of the residential building stock is of high vulnerability, and the remaining 19% is of very high vulnerability to an earthquake event. About 32% of the commercial building inventory is of medium vulnerability to an earthquake, 20% of the stock is of high vulnerability, and the remaining 48% of the inventory has a very high vulnerability to a seismic event. St. John has construction on steep sloping ground, but most structures are more recent and better built due to economic reasons.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

**TABLE 4.20** ***Estimated Earthquake Exposure and Vulnerability (St. Thomas)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 91% | 0.00 | 0.00 | 0.00 | 42% | 58% |
| No. of Residential | 21,262 | 0 | 0 | 0 | 9,807 | 13,558 |
| Value of Residential | $5,848,955,616 | $0 | $0 | $0 | $2,697,864,850 | $3,729,558,904 |
| | | | | | | |
| % of Commercial | 96% | 0.00 | 0.00 | 0.00 | 20% | 80% |
| No. of Commercial | 2,098 | 0 | 0 | 0 | 435 | 1,750 |
| Value of Commercial | $1,747,859,317 | $0 | $0 | $0 | $362,197,527 | $1,458,489,262 |

**TABLE 4.21** ***Estimated Earthquake Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 70% | 0% | 0% | 75% | 5% | 20% |
| No. of Residential | 15,398 | 0 | 0 | 16,497 | 1,100 | 4,399 |
| Value of Residential | 4,057,013,200 | 0 | 0 | 3,042,759,900 | 202,850,660 | 811,402,640 |
| | | | | | | |
| % of Commercial | 84% | 0% | 0% | 73% | 0% | 27% |
| No. of Commercial | 701 | 0 | 0 | 512 | 0 | 189 |
| Value of Commercial | 1,210,797,916 | 0 | 0 | 883,882,479 | 0 | 326,915,437 |

**TABLE 4.22** ***Estimated Earthquake Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 71% | 0 | 0 | 71% | 11% | 19% |
| No. of Residential | 1,595 | 0 | 0 | 1,133 | 175 | 303 |
| Value of Residential | 583,125,398 | 0 | 0 | 414,019,033 | 64,143,794 | 110,793,826 |
| | | | | | | |
| % of Commercial | 85% | 0 | 0 | 32% | 20% | 48% |
| No. of Commercial | 69 | 0 | 0 | 22 | 14 | 33 |
| Value of Commercial | 288,638,126 | 0 | 0 | 92,364,200 | 57,727,625 | 138,546,300 |

## Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

**TABLE 4.23** ***Estimated Earthquake Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| **Critical Facilities** | | | | | | | |
| Police Stations | 5 | 1 | | | 1 | 3 | 12,727,552 |
| Fire Stations | 5 | 1 | | 1 | 1 | 2 | 7,792,547 |
| Emergency Response | | | | 1 | | | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | | | | 4 | 1 | 95,838,253 |
| Government Buildings | 11 | | | 3 | | 8 | 118,417,923 |
| Shelters | 5 | 1 | | 1 | | 3 | 123,556,219 |
| **Transportation Infrastructure** | | | | | | | |
| Marine Ports | 4 | 1 | | 1 | | 2 | 26,038,712 |
| Airport | 1 | 1 | | | | | 22,475,260 |
| **Utilities** | | | | | | | |
| Electrical Power Plant | | | | | | 1 | 51,172,046 |
| Sewage Treatment Plant | 1 | | | | 1 | | 61,792,356 |
| Water Treatment Plant | 1 | | | | 1 | | |
| WAPA Tanks | 1 | | | | | 1 | |
| Pumping Station | 1 | | | | 1 | | |
| | | | | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.24** ***Estimated Earthquake Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 6 | 1 | | 3 | 1 | 1 | 63,719,946 |
| Fire Stations | 5 | 1 | | | 1 | 3 | 9,269,808 |
| Emergency Response | 1 | | | 1 | | | - |
| Hospital/ Medical Clinic | 3 | | | 2 | | 1 | 135,990,389 |
| Government Buildings | 12 | | | 6 | 2 | 4 | 121,046,648 |
| Shelters/Special Needs | 11 | | 1 | 3 | 1 | 6 | 173,286,506 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 5 | 5 | | | | | 9,922,078 |
| Airport | 1 | | | 1 | | | 57,686,500 |
| Utilities | | | | | | | |
| Electrical Power Plant | 1 | | | | 1 | | 51,917,850 |
| Sewage Pumps | 14 | 3 | 3 | 6 | 2 | | 110,067,300 |
| Wastewater Treatment Plant | 1 | | | | 1 | | |
| Water Treatment Plant | 1 | 1 | | | | | |
| Water Pumps | 8 | | | 4 | 2 | 2 | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.25 *Estimated Earthquake Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 2 | | 1 | | 1 | | 4,321,296 |
| Fire Stations | 2 | | | 1 | | 1 | 4,845,666 |
| Emergency Response | 1 | | | 1 | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | 1 | | | | 1 | 17,590,586 |
| Government Buildings | 3 | | 1 | | | 2 | 13,159,486 |
| Shelters/Special Needs | 5 | | | 1 | 1 | 3 | 52,473,202 |
| Transportation Infrastructure | | | | | | | - |
| Marine Ports | 1 | 1 | | | | | 2,884,325 |
| Airport | N/A | | | | | | -- |
| Utilities | | | | | | | - |
| Electrical Power Plant | 1 | | | | 1 | | 15,575,355 |
| WAPA Desalinization Plant | 1 | | | 1 | | | |
| WAPA Water Tank | 1 | | | | 1 | | |
| Sewage Treatment Plant | 1 | | | | 1 | | |
| Potable Water Tank | 1 | | | | 1 | | |
| | | | | | | | 33,518,154 |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

## 4.6.3 RIVERINE FLOODING

This section discusses the population and the proportion and value of buildings located in areas affected by a riverine flooding hazard. It also provides an estimate of proportion of assets located in riverine flooding hazard areas.

### Social Impacts

Table 4.25 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.26** ***Social Impacts (Riverine Flooding)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 3,796 | 7% | 1,085 | 2% |
| | | | | | |
| St. Croix | 56,404 | 4,512 | 8% | 1,128 | 2% |
| | | | | | |
| St. John | 4,447 | 267 | 6% | 44 | 1% |

### Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 141 residential properties exposed to this hazard on St. Thomas. On St. Croix there was an increase of 70 residential properties exposed to this hazard, while on St. John the total number of residential properties exposed to this hazard increased by 14. On St. Thomas there were 21 more commercial properties exposed to this hazard. On St. Croix there were 2 more commercial properties exposed to this hazard. On St. John there were not any additional commercial properties exposed to this hazard.

- On St. Thomas approximately 23% percent of the residential building stock and 36% of the commercial building stock is considered to be vulnerable to river flooding. Of this percentage, approximately 47% of the residential building stock is of medium vulnerability and the remaining 53% is of high vulnerability to river flooding. About 36% of the commercial building inventory has a low vulnerability to river flooding, and the remaining 79% of the inventory has a high vulnerability to such flooding.

- On St. Croix approximately 12% percent of the residential building stock and 10% of the commercial building stock is considered to be vulnerable to river flooding. Of this percentage, approximately 68% of the residential building stock is of medium vulnerability and the remaining 32% is of high vulnerability to river flooding. About 51% of the commercial building inventory has a low vulnerability to river flooding, and the remaining 49% of the inventory has a high vulnerability to such flooding.

- On St. John approximately 12% percent of the residential building stock and 10% of the commercial building stock is considered to be vulnerable to river flooding. Of this percentage, approximately 81% of the residential building stock is of medium vulnerability and the remaining 19% is of high vulnerability to river flooding. About 51% of the commercial building inventory has a moderate vulnerability to river flooding, and the remaining 49% of the inventory has a high vulnerability to such flooding.

**TABLE 4.27** ***Estimated Riverine Flooding Exposure and Vulnerability (St. Thomas)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 23% | 0.00 | 0.00 | 0.47 | 0.53 | 0.00 |
| No. of Residential | 5,374 | 0 | 0 | 2,519 | 2,855 | 0 |
| Value of Residential | $1,478,307,463 | $0.00 | $0.00 | $692,844,520 | $785,462,943 | $0.00 |
| | | | | | | |
| % of Commercial | 36% | 0.00 | 0.00 | 20 | 79 | 0.00 |
| No. of Commercial | 787 | 0 | 0 | 156 | 630 | 0 |
| Value of Commercial | $655,447,244 | $0 | $0 | $130,391,110 | $525,056,134 | 0 |

**TABLE 4.28** ***Estimated Riverine Flooding Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 12% | 0% | 0% | 68% | 32% | 0% |
| No. of Residential | 2,640 | 0 | 0 | 1,795 | 845 | 0 |
| Value of Residential | 695,487,977 | 0 | 0 | 472,931,824 | 222,556,153 | 0 |
| | | | | | | |
| % of Commercial | 10% | 0% | 0% | 51% | 49% | 0% |
| No. of Commercial | 83 | 0 | 0 | 43 | 41 | 0 |
| Value of Commercial | 144,142,609 | 0 | 0 | 73,512,731 | 70,629,878 | 0 |

**TABLE 4.29** ***Estimated Riverine Flooding Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 24% | 0% | 0% | 81% | 19% | 0% |
| No. of Residential | 539 | 0 | 0 | 437 | 102 | 0 |
| Value of Residential | 197,112,811 | 0 | 0 | 159,661,377 | 37,451,434 | 0 |
| | | | | | | |
| % of Commercial | 15% | 0% | 0% | 44% | 48% | 0% |
| No. of Commercial | 12 | 0 | 0 | 5 | 6 | 0 |
| Value of Commercial | 50,936,140 | 0 | 0 | 22,411,902 | 24,449,347 | 0 |

It may be overly simplistic to determine flood vulnerability as a yes or no per the location of the structure in, or outside of, the floodplain. Flood vulnerability for this Plan Update was determined using the 100-year flood zone as an indicator of the overall hazard. The digital version of these maps was derived from updated DFIRMS. However, the updated DFIRMS did not have Base Flood Elevations (BFE) for all mapped riverine areas.

Therefore, BFEs were utilized where present and a terrain model was utilized to infer flood elevations where the BFE data was absent. The resulting analysis utilized a GIS to generate a Triangular Irregular Network (TIN) of the water surface elevation. Using GIS overlay techniques,

the terrain were subtracted from TIN (an intersection of the flood polygon with the terrain model) to determine an estimated depth of flooding.

This method was found to be suitable for estimating zones experiencing different flood depths within the 100-year flood area. The depth intervals were broken out into five categories of different flood depths between 4 to 25 feet to define the flood hazard as very low, low, moderate, high and very high. Therefore, your highest areas of vulnerability would be found in the center of the 100-year floodplain, where the depths are the greatest. In this Plan Update, most of the residential and commercial structures in the Territory were found to be in moderate to high flood hazard intensity. This indicates that most the building stock estimated to be vulnerable to flooding were within the defined 100-year floodplain.

The flood hazard information in this Plan Update was used to integrate a Severe Repetitive Loss Strategy in the Mitigation Strategy. As in the 2011 Plan Update, general GIS maps that graphically show Special Flood Hazard Area (SFHA) were used to identify residential and commercial areas that experience repetitive flooding. Mapping of individual structures was not conducted during this Plan Update.

## Critical Facilities

The following tables highlight the results of the vulnerability assessment of each state-owned or operated facility to the riverine flood hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the islands of St. Thomas, St. Croix and St. John.

The tables below show potential dollar exposure to Riverine flood hazard on St. Thomas, St. Croix and St. John.

**TABLE 4.30** ***Estimated Riverine Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 5 | 2 | | | 1 | 2 | 12,727,552 |
| Fire Stations | 5 | 2 | | 1 | | 2 | 7,792,547 |
| Emergency Response | 1 | 1 | | | | | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | 3 | 1 | | | 1 | 95,838,253 |
| Government Buildings | 11 | 3 | | 1 | 2 | 5 | 118,417,923 |
| Shelters | 5 | 3 | | 1 | 1 | | 123,556,219 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 4 | 3 | | 1 | | | 26,038,712 |
| Airport | 1 | 1 | | | | | 22,475,260 |
| Utilities | | | | | | | |
| Electrical Power Plant | | | | | | | 51,172,046 |
| Sewage Treatment Plant | 1 | | | | 1 | | 61,792,356 |
| Water Treatment Plant | 1 | | | | 1 | | |
| WAPA Tanks | 1 | 1 | | | | | |
| Pumping Station | 1 | 1 | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.31** ***Estimated Riverine Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 6 | 6 | | | | | 63,719,946 |
| Fire Stations | 5 | 5 | | | | | 9,269,808 |
| Emergency Response | 1 | 1 | | | | | - |
| Hospital/ Medical Clinic | 3 | 3 | | | | | 135,990,389 |
| Government Buildings | 12 | 9 | | 1 | 1 | | 121,046,648 |
| Shelters/Special Needs | 11 | 11 | | | | 1 | 173,286,506 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 5 | 5 | | | | | 9,922,078 |
| Airport | 1 | 1 | | | | | 57,686,500 |
| Utilities | | | | | | | |
| Electrical Power Plant | 1 | | 1 | | | | 51,917,850 |
| Sewage Pumps | 14 | **12** | 2 | | | | 110,067,300 |
| Wastewater Treatment Plant | 1 | **1** | | | | | |
| Water Treatment Plant | 1 | | 1 | | | | |
| Water Pumps | 8 | **6** | 1 | 1 | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.32** ***Estimated Riverine Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| **Critical Facilities** | | | | | | | |
| Police Stations | 2 | 1 | | | 1 | | 4,321,296 |
| Fire Stations | 2 | 2 | | | | | 4,845,666 |
| Emergency Response | 1 | 1 | | | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | 2 | | | | | 17,590,586 |
| Government Buildings | 3 | 2 | | | 1 | | 13,159,486 |
| Shelters/Special Needs | 5 | 3 | | | | 2 | 52,473,202 |
| **Transportation Infrastructure** | | | | | | | - |
| Marine Ports | 1 | | | | | | 2,884,325 |
| Airport | N/A | | | | | | -- |
| **Utilities** | | | | | | | - |
| Electrical Power Plant | 1 | 1 | | | | | 15,575,355 |
| WAPA Desalinization Plant | 1 | 1 | | | | | |
| WAPA Water Tank | 1 | 1 | | | | | |
| Sewage Treatment Plant | 1 | | | | 1 | | |
| Potable Water Tank | 1 | 1 | | | | | 33,518,154 |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

## 4.6.4 COASTAL FLOODING

This section discusses the population and the proportion and value of buildings located in areas affected by a coastal flood hazard. It also provides an estimate of proportion of assets located in coastal flood hazard areas.

### Social Impacts

Table 4.33 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.33** ***Social Impacts (Coastal Flooding)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 1,085 | 2% | 16 | 0.03% |
| | | | | | |
| St. Croix | 56,404 | 1,128 | 2% | 23 | 0.04% |
| | | | | | |
| St. John | 4,447 | 89 | 2% | 2 | 0.04% |

### Physical and Economic Impacts

In this Plan update economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 43 residential properties exposed to this hazard on St. Thomas. On St. Croix there was an increase 29 residential properties, while on St. John the total number of residential properties exposed increased by 6. On St. Thomas the total number of commercial properties increased by 2. On St. Croix there were 1 more commercial property exposed to this hazard and on St. John, there was no change.

- On St. Thomas approximately 7% percent of the residential building stock and 4% of the commercial building stock is considered to be vulnerable to coastal flooding. Of this percentage, approximately 2% of the residential building stock is of medium vulnerability, 45% of the residential building stock is of high vulnerability, and the remaining 53% is of very high vulnerability to coastal flooding. About 1% of the commercial building inventory is of medium vulnerability to coastal flooding, 19% of the stock is of high vulnerability, and the remaining 80% of the inventory has a very high vulnerability to such flooding.

- On St. Croix approximately 5% percent of the residential building stock and 2% of the commercial building stock is considered to be vulnerable to coastal flooding. Of this percentage, approximately 1% of the residential building stock is of medium vulnerability, 76% of the residential building stock is of high vulnerability, and the remaining 24% is of very high vulnerability to coastal flooding. About 4% of the commercial building inventory is of medium vulnerability to coastal flooding, 67% of the stock is of high vulnerability, and the remaining 29% of the inventory has a very high vulnerability to such flooding.

- On St. John approximately 10% percent of the residential and commercial building stock are considered to be vulnerable to coastal flooding. Of this percentage, approximately 1% of the residential building stock is of medium vulnerability, 76% of the residential building stock is of high vulnerability, and the remaining 23% is of very high vulnerability to coastal flooding. About 4% of the commercial building inventory is of medium vulnerability to coastal flooding, 47% of the stock is of high vulnerability, and the remaining 49% of the inventory has a very high vulnerability to such flooding.

The tables below show potential dollar exposure to the coastal flooding hazard on St. Thomas, St. Croix and St. John.

***TABLE 4.34* Estimated Coastal Flooding Exposure and Vulnerability (St. Thomas)**

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 7% | 0.00 | 0.00 | 0.02 | 0.45 | 0.53 |
| No. of Residential | 1,636 | 0 | 0 | 29 | 738 | 869 |
| Value of Residential | $449,919,663 | 0 | 0 | 7,936,939 | 202,928,784 | 239,053,939 |
| | | | | | | |
| % of Commercial | 4% | 0.00 | 0.00 | 0.01 | 0.19 | 0.80 |
| No. of Commercial | 87 | 0 | 0 | 1 | 16 | 70 |
| Value of Commercial | $72,827,472 | $0 | $0 | $929,427 | $13,558,474 | $58,339,570 |

**TABLE 4.35** ***Estimated Coastal Flooding Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 5% | 0% | 0% | 1% | 76% | 24% |
| No. of Residential | 1,100 | 0 | 0 | 11 | 836 | 264 |
| Value of Residential | 289,786,657 | 0 | 0 | 2,897,867 | 220,237,859 | 69,548,798 |
| | | | | | | |
| % of Commercial | 2% | 0 | 0 | 4% | 67% | 29% |
| No. of Commercial | 17 | 0 | 0 | 3 | 54 | 23 |
| Value of Commercial | 28,828,522 | 0 | 0 | 57,657,044 | 965,755,481 | 418,013,566 |

**TABLE 4.36** ***Estimated Coastal Flooding Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 10% | 0% | 0% | 1% | 76% | 23% |
| No. of Residential | 225 | 0 | 0 | 2 | 171 | 52 |
| Value of Residential | 82,130,338 | 0 | 0 | 821,303 | 62,419,057 | 18,889,978 |
| | | | | | | |
| % of Commercial | 10% | 0 | 0 | 4% | 47% | 49% |
| No. of Commercial | 8 | 0 | 0 | 0 | 4 | 4 |
| Value of Commercial | 33,957,427 | 0 | 0 | 1,358,297 | 15,959,990 | 16,639,139 |

## Critical Facilities

The following tables highlight the results of the vulnerability assessment of each state-owned or operated facility to the coastal flood hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

**TABLE 4.37** ***Estimated Coastal Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 5 | 5 | | | | | 12,727,552 |
| Fire Stations | 5 | 5 | | | | | 7,792,547 |
| Emergency Response | 1 | 1 | | | | | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | 5 | | | | | 95,838,253 |
| Government Buildings | 11 | 11 | | | | | 118,417,923 |
| Shelters | 5 | 5 | | | | | 123,556,219 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 4 | 4 | | | | | 26,038,712 |
| Airport | 1 | 1 | | | | | 22,475,260 |
| Utilities | | | | | | | |
| Electrical Power Plant | 1 | 1 | | | | | 51,172,046 |
| Sewage Treatment Plant | 1 | 1 | | | | | 61,792,356 |
| Water Treatment Plant | 1 | 1 | | | | | |
| WAPA Tanks | 1 | 1 | | | | | |
| Pumping Station | 1 | 1 | | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.38** ***Estimated Coastal Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 6 | 6 | | | | | 63,719,946 |
| Fire Stations | 5 | 5 | | | | | 9,269,808 |
| Emergency Response | 1 | 1 | | | | | - |
| Hospital/ Medical Clinic | 3 | 3 | | | | | 135,990,389 |
| Government Buildings | 12 | 11 | | | | 1 | 121,046,648 |
| Shelters/Special Needs | 11 | 11 | | | | | 173,286,506 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 5 | 5 | | | | | 9,922,078 |
| Airport | 1 | 1 | | | | | 57,686,500 |
| Utilities | | | | | | | |
| Electrical Power Plant | 1 | 1 | | | | | 51,917,850 |
| Sewage Pumps | 14 | 14 | | | | | 110,067,300 |
| Wastewater Treatment Plant | 1 | 1 | | | | | |
| Water Treatment Plant | 1 | 1 | | | | | |
| Water Pumps | 8 | 8 | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.39** ***Estimated Coastal Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 2 | 2 | | | | | 4,321,296 |
| Fire Stations | 2 | 2 | | | | | 4,845,666 |
| Emergency Response | 1 | 1 | | | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | 2 | | | | | 17,590,586 |
| Government Buildings | 3 | 2 | | | | 1 | 13,159,486 |
| Shelters/Special Needs | 5 | 5 | | | | | 52,473,202 |
| Transportation Infrastructure | | | | | | | - |
| Marine Ports | 1 | 1 | | | | | 2,884,325 |
| Airport | N/A | | | | | | -- |
| Utilities | | | | | | | - |
| Electrical Power Plant | 1 | | | | | 1 | 15,575,355 |
| WAPA Desalinization Plant | 1 | 1 | | | | | |
| WAPA Water Tank | 1 | | | | | 1 | |
| Sewage Treatment Plant | 1 | | | | | 1 | |
| Potable Water Tank | 1 | 1 | | | | | 33,518,154 |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

## 4.6.5 HURRICANE WINDS

This section discusses the population and the proportion and value of buildings located in areas affected by a Hurricane Winds hazard. It also provides an estimate of proportion of assets located in Hurricane Winds hazard areas.

Although there no areas of the US Virgin Islands that are totally free from hurricane force winds, the vulnerability of each islands building inventory is quite different. The tables above indicate that the vulnerability of each island's building stock differs. Since vulnerability refers to the potential of the built environment to be damaged or destroyed, the number of certain model buildings types that found throughout each island, e.g., single-family wood-frame buildings, may experience particular states of damage to the hurricane wind hazard (ranging from Very Low, Low, Moderate, High, to Very High).

### Social Impacts

Table 4.40 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.40** ***Social Impacts (Hurricane Winds)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 11,388 | 21% | 2,711 | 5% |
| | | | | | |
| St. Croix | 56,404 | 14,101 | 25% | 2,820 | 5% |
| | | | | | |
| St. John | 4,447 | 1,067 | 24% | 267 | 6% |

### Physical and Economic Impacts

In this Plan update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 331 residential properties exposed to this hazard on St. Thomas. On St. Croix, there were 9239 residential properties exposed to the hazard, which represented an increase of 243 properties. On St. John, there were 786 residential properties, which represented an increase of 2 structures that are exposed high winds. On St. Thomas, there were 41 more commercial properties

exposed to this hazard. While in St. Croix, there were 31 more commercial properties and no increase in commercial properties on St. John.

- On St. Thomas, approximately 54% percent of the residential building stock and 70% of the commercial building stock is considered to be vulnerable to hurricane winds. Of this percentage, 1% of the residential building stock is of low vulnerability to hurricane force winds, 94% is of medium vulnerability, and the remaining 5% is of high vulnerability to such winds.  Nearly 1% of the commercial building inventory has a low vulnerability to hurricane force winds, and the remaining 99% of commercial building inventory has a medium vulnerability to such winds.

- On St. Croix, approximately 42% percent of the residential building stock and 58% of the commercial building stock is considered to be vulnerable to hurricane winds. Of this percentage, 83% of the residential building stock is of low vulnerability to hurricane force winds, 12% is of medium vulnerability, and the remaining 5% is of high vulnerability to such winds. Nearly 69% of the commercial building inventory has a low vulnerability to hurricane force winds, and the remaining 31% of the inventory has a medium vulnerability to such winds.

- On St. John, approximately 35% percent of the residential and commercial building stock are is considered to be vulnerable to hurricane winds. Of this percentage, 86% of the residential building stock is of low vulnerability to hurricane force winds, 9% is of medium vulnerability, and the remaining 5% is of high vulnerability to such winds. Nearly 73% of the commercial building inventory has a low vulnerability to hurricane force winds, and the remaining 27% of the inventory has a medium vulnerability to such winds.

The tables below show potential dollar exposure to the hurricane hazard on St. Thomas, St. Croix and St. John.

**TABLE 4.41** ***Estimated Hurricane Exposure and Vulnerability (St. Thomas)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 54% | 0% | 1% | 94% | 5% | 0% |
| No. of Residential | 12,617 | 0 | 126 | 11860 | 631 | 0 |
| Value of Residential | $3,470,808,827 | $0 | $34,708,088 | $3,262,560,297 | $173,540,441 | $0 |
| | | | | | | |
| % of Commercial | 70% | 0% | 1% | 99% | 0% | 0% |
| No. of Commercial | 1530 | 0 | 28 | 2157 | 0 | 0 |
| Value of Commercial | $1,274,480,752 | $0 | $23,235,666 | $1,797,451,122 | $0 | $0 |

**TABLE 4.42** ***Estimated Hurricane Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 42% | 0% | 83% | 12% | 5% | 0% |
| No. of Residential | 9,239 | 0 | 7,668 | 1,109 | 462 | 0 |
| Value of Residential | 2,434,207,920 | 0 | 2,020,392,573 | 292,104,950 | 121,710,396 | 0 |
| | | | | | | |
| % of Commercial | 58% | 0% | 69% | 31% | 0% | 0% |
| No. of Commercial | 484 | 0 | 334 | 150 | 0 | 0 |
| Value of Commercial | 1,441,426,090 | 0 | 994,584,002 | 446,842,088 | 0 | 0 |

**TABLE 4.43** ***Estimated Hurricane Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 35% | 0 | 0.86 | 0.09 | 0.05 | 0 |
| No. of Residential | 786 | 0 | 676 | 71 | 39 | 0 |
| Value of Residential | 287,456,182 | 0 | 247,212,317 | 25,871,056 | 14,372,809 | 0 |
| | | | | | | |
| % of Commercial | 35% | 0 | 0.73 | 0.27 | 0 | 0 |
| No. of Commercial | 28 | 0 | 21 | 8 | 0 | 0 |
| Value of Commercial | 118,850,993 | 0 | 86,761,225 | 32,089,768 | 0 | 0 |

## Critical Facilities and Infrastructure

The following tables highlight the results of the vulnerability assessment of each state-owned or operated facility to the Hurricane Wind hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

**TABLE 4.44** ***Estimated Hurricane Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 5 | | | 3 | 1 | | 12,727,552 |
| Fire Stations | 5 | | 1 | 2 | 2 | | 7,792,547 |
| Emergency Response | 1 | | 1 | | | | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | | 1 | 2 | 2 | | 95,838,253 |
| Government Buildings | 11 | | 2 | 1 | 6 | 2 | 118,417,923 |
| Shelters | 5 | | | 1 | 4 | | 123,556,219 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 4 | 1 | 1 | 1 | 1 | | 26,038,712 |
| Airport | 1 | | 1 | | | | 22,475,260 |
| Utilities | | | | | | | |
| Electric Power Plant | 1 | | 1 | | | | 51,172,046 |
| Sewage Treatment Plant | 1 | | 1 | | | | 61,792,356 |
| Water Treatment Plant | 1 | | 1 | | | | |
| WAPA Tanks | 1 | | 1 | | | | |
| Pumping Station | 1 | | 1 | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**<u>TABLE 4.45</u> *Estimated Hurricane Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 6 | | 4 | 2 | | | 63,719,946 |
| Fire Stations | 5 | 1 | | | 1 | 3 | 9,269,808 |
| Emergency Response | 1 | | 1 | | | | - |
| Hospital/ Medical Clinic | 3 | | | 2 | | 1 | 135,990,389 |
| Government Buildings | 12 | | | 6 | 2 | 4 | 121,046,648 |
| Shelters/Special Needs | 11 | | 1 | 3 | 1 | 6 | 173,286,506 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 5 | 4 | 1 | | | | 9,922,078 |
| Airport | 1 | | | 1 | | | 57,686,500 |
| Utilities | | | | | | | |
| Electrical Power Plant | 1 | | 1 | | | | 51,917,850 |
| Sewage Pumps | 14 | 3 | 2 | 3 | 4 | 2 | 110,067,300 |
| Wastewater Treatment Plant | 1 | | 1 | | | | |
| Water Treatment Plant | 1 | | 1 | | | | |
| Water Pumps | 8 | | 8 | | | | |
| Water Tanks | 12 | 2 | 3 | 3 | 4 | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.46** ***Estimated Hurricane Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 2 | | 1 | | 1 | | 4,321,296 |
| Fire Stations | 2 | | 1 | | 1 | | 4,845,666 |
| Emergency Response | 1 | | 1 | | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | | 1 | | | 1 | 17,590,586 |
| Government Buildings | 3 | | 2 | | 1 | | 13,159,486 |
| Shelters/Special Needs | 5 | | | 2 | 3 | | 52,473,202 |
| Transportation Infrastructure | | | | | | | - |
| Marine Ports | 1 | | 1 | | | | 2,884,325 |
| Airport | N/A | | | | | | |
| Utilities | | | | | | | - |
| Electrical Power Plant | 1 | | 1 | | | | 15,575,355 |
| WAPA Desalinization Plant | 1 | | 1 | | | | |
| WAPA Water Tank | 1 | | 1 | | | | |
| Sewage Treatment Plant | 1 | | 1 | | | | |
| Potable Water Tank | 1 | 1 | | | | | 33,518,154 |
| | | | | | | | |
| | | | | | | | |

## 4.6.6 RAIN-INDUCED LANDSLIDES

This section discusses the population and the proportion and value of buildings located in areas affected by a rain-induced landslides. It also provides an estimate of proportion of assets located in areas that are susceptible to rain-induced landslides

### Social Impacts

Table 4.48 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.48** ***Social Impacts (Rain-induced Landslide)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 9,246 | 17% | 2,278 | 4% |
| | | | | | |
| St. Croix | 56,404 | 3,462 | 6% | 853 | 2% |
| | | | | | |
| St. John | 4,447 | 1,516 | 34% | 146 | 3% |

### Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings that are susceptible to this hazard. The findings of the vulnerability assessment for this Plan Update indicate that there are 11,682 residential structures and 830 commercial structures exposed to this hazard on St. Thomas. On St. Croix there are 3,959 residential structures and 150 commercial structures exposed to this hazard on St. Thomas. On St. John there are 876 residential structures and 30 commercial structures exposed to this hazard.

- On St. Thomas approximately 50% percent of the residential building stock and 38% of the commercial building stock is considered to be vulnerable rain-induced landslides. Of this percentage, approximately 13% of the residential building stock is of high vulnerability and the remaining 27% is of very high vulnerability to rain-induced landslide event. Commercial structures are considered to be less vulnerable to rain–induced landslide with the majority of structures falling into the very low and low susceptibility categories.

- On St. Croix approximately 18% percent of the residential building stock susceptible to landslide hazards. Of this percentage, approximately 17% of the residential building stock is of medium vulnerability, 13% of the residential building stock is of high vulnerability, and the remaining 5% is of very high vulnerability to rain-induced landslide. None of the commercial building inventory falls into the medium, high or very high vulnerability hazard rating for a rain-induced landslide.

- On St. John approximately 39% percent of the residential building stock and 37% of the commercial building stock is considered to be vulnerable to a rain-induced landslide. Of this percentage, approximately 24% of the residential building stock is of medium vulnerability, 27% of the residential building stock is of high vulnerability, and the remaining 12% is of very high vulnerability to a rain-induced landslide event. None of the commercial building inventory is of medium high or very high vulnerability rating to a rain-induced landslide event.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

**TABLE 4.49** ***Estimated Rain-Induced Landslide Exposure and Vulnerability (St. Thomas)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 50% | 5% | 33% | 22% | 13% | 27% |
| No. of Residential | 11,682 | 629 | 3,834 | 2,546 | 1,463 | 3,211 |
| Value of Residential | $3,213,711,877 | $173,052,574 | $1,054,598,986 | $700,405,281 | $402,405,769 | $883,249,267 |
| | | | | | | |
| % of Commercial | 38% | 13% | 87% | 0 | 0 | 0 |
| No. of Commercial | 830 | 109 | 721 | 0 | 0 | 0 |
| Value of Commercial | $691,860,980 | $91,034,339 | $600,826,640 | $0 | $0 | $0 |

**TABLE 4.50** ***Estimated Rain-Induced Landslide Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 18% | 46% | 20% | 17% | 13% | 5% |
| No. of Residential | 3959 | 1,805 | 790 | 654 | 504 | 207 |
| Value of Residential | $1,043,231,966 | 475,623,664 | 208,168,636 | 172,259,816 | 132,684,653 | 54,495,197 |
| | | | | | | |
| % of Commercial | 18% | 70% | 30% | 0 | 0 | 0 |
| No. of Commercial | 150 | 105 | 46 | 0 | 0 | 0 |
| Value of Commercial | $259,456,696 | 180,833,455 | 78,623,241 | 0 | 0 | 0 |

**TABLE 4.51** ***Estimated Rain-Induced Landslide Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 39% | 15% | 22% | 24% | 27% | 12% |
| No. of Residential | 876 | 130 | 197 | 206 | 236 | 107 |
| Value of Residential | $320,308,317 | 47,473,212 | 71,913,125 | 75,445,644 | 86,187,058 | 39,289,278 |
| | | | | | | |
| % of Commercial | 37% | 41% | 59% | | | |
| No. of Commercial | 30 | 12 | 18 | 0 | 0 | 0 |
| Value of Commercial | $125,642,478 | 50,936,140 | 74,706,338 | 0 | 0 | 0 |

## Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

**TABLE 4.52** ***Estimated Rain-Induced Landslide Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 5 | 3 | 2 | | | | 12,727,552 |
| Fire Stations | 5 | 3 | 2 | | | | 7,792,547 |
| Emergency Response | 1 | 1 | | | | | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | 4 | 1 | | | | 95,838,253 |
| Government Buildings | 11 | 10 | 1 | | | | 118,417,923 |
| Shelters | 5 | 2 | 1 | 1 | 1 | | 123,556,219 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 4 | 4 | | | | | 26,038,712 |
| Airport | 1 | 1 | | | | | 22,475,260 |
| Utilities | | | | | | | |
| Electrical Power Generating Plants | 1 | 1 | | | | | 51,172,046 |
| Sewage Treatment Plant | 1 | | 1 | | | | 61,792,356 |
| Water Treatment Plant | 1 | | 1 | | | | |
| WAPA Tanks | 1 | 1 | | | | | |
| Pumping Station | 1 | | 1 | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.53** ***Estimated Rain-Induced Landslide Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 6 | 6 | | | | | 63,719,946 |
| Fire Stations | 5 | 5 | | | | | 9,269,808 |
| Emergency Response | N/A | | | | | | - |
| Hospital/ Medical Clinic | 3 | 3 | | | | | 135,990,389 |
| Government Buildings | 12 | 11 | 1 | | | | 121,046,648 |
| Shelters/Special Needs | 11 | 11 | | | | | 173,286,506 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 5 | 5 | | | | | 9,922,078 |
| Airport | 1 | 1 | | | | | 57,686,500 |
| Utilities | | | | | | | |
| Electrical Power Generating Plants | 1 | 1 | | | | | 51,917,850 |
| Sewage Pumps | 14 | 14 | | | | | 110,067,300 |
| Wastewater Treatment Plant | 1 | 1 | | | | | |
| Water Treatment Plant | 1 | 1 | | | | | |
| Water Pumps | 8 | 5 | 3 | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.54** ***Estimated Rain-Induced Landslide Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 2 | 1 | 1 | | | | 4,321,296 |
| Fire Stations | 2 | 1 | 1 | | | | 4,845,666 |
| Emergency Response | 1 | 1 | | | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | 1 | 1 | | | | 17,590,586 |
| Government Buildings | 3 | 2 | 1 | | | | 13,159,486 |
| Shelters/Special Needs | 5 | 3 | 2 | | | | 52,473,202 |
| Transportation Infrastructure | | | | | | | - |
| Marine Ports | 1 | 1 | | | | | 2,884,325 |
| Airport | N/A | | | | | | -- |
| Utilities | | | | | | | - |
| Electrical Power Generating Plants | 1 | 1 | | | | | 15,575,355 |
| WAPA Desalinization Plant | 1 | 1 | | | | | |
| WAPA Water Tank | 1 | 1 | | | | | |
| Sewage Treatment Plant | 1 | 1 | | | | | |
| Potable Water Tank | 1 | 1 | | | | | 33,518,154 |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

## 4.6.7 TSUNAMI

This section discusses the population and the proportion and value of buildings located in areas affected by a tsunami hazard. It also provides an estimate of proportion of assets located in tsunami hazard areas.

### Social Impacts

Table 4.55 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.55** ***Social Impacts (Tsunami)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 2,440 | 5% | 813 | 2% |
| | | | | | |
| St. Croix | 56,404 | 2,758 | 5% | 919 | 2% |
| | | | | | |
| St. John | 4,447 | 141 | 3% | 71 | 2% |

### Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 1,476 residential properties exposed to this hazard on St. Thomas. For St. Croix there were 1011 less residential properties exposed to this hazard, while on St. John the total number of residential properties exposed decreased by 111. On St. Thomas there were 253 more commercial properties exposed to this hazard. On St. Croix, there were 17 more commercial properties, while on St. John there was an increase of 4 commercial properties exposed to this hazard.

- All building types are equally vulnerable to a tsunami. No regular building structure can be built to withstand a tsunami, as it would not be economically or realistically feasible to do so, given the rare and random nature of this hazard. Of all buildings exposed to this hazard, approximately 40% of the residential building stock is of high vulnerability and the remaining 60% is of very high vulnerability to a tsunami event. The commercial buildings 20% are of high vulnerability and 80% fall in the very high category.

- Tsunamis can devastate development along coastlines, causing widespread property damage and loss of life. Both residential and commercial structures are considered to be equally vulnerable to the tsunami hazard. Tsunamis can cause significant loss of life, especially in low-lying harbors of Charlotte Amalie, Christiansted and Frederiksted.

- Tsunamis have the potential to have an enormous impact of the tourist industry. Cruise ships and their passengers are particularly exposed to this hazard, especially while in harbor.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

**TABLE 4.56** ***Estimated Tsunami Exposure and Vulnerability (St. Thomas)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 18% | 0 | 0 | 0 | 40% | 60% |
| No. of Residential | 4,206 | 0 | 0 | 0 | 1,682 | 2,523 |
| Value of Residential | $1,156,936,276 | $0 | $0 | $0 | $462,774,510 | $694,161,765 |
| | | | | | | |
| % of Commercial | 33% | 0 | 0 | 0 | 20% | 80% |
| No. of Commercial | 721 | 0 | 0 | 0 | 144 | 577 |
| Value of Commercial | $ 600,826,640 | $ 0 - | $ 0 - | $ 0 - | $ 120,165,328 | $ 480,661,312 |

**TABLE 4.57** ***Estimated Tsunami Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 11% | 0 | 0 | 0 | 40% | 60% |
| No. of Residential | 2,510 | 0 | 0 | 0 | 1,004 | 1,506 |
| Value of Residential | 661,293,152 | 0 | 0 | 0 | 264,517,261 | 396,775,891 |
| | | | | | | |
| % of Commercial | 5% | 0 | 0 | 0 | 20% | 80% |
| No. of Commercial | 41 | 0 | 0 | 0 | 8 | 33 |
| Value of Commercial | 70,485,736 | 0 | 0 | 0 | 14,097,147 | 56,388,589 |

**TABLE 4.58** ***Estimated Tsunami Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 13% | 0 | 0 | 0 | 40% | 60% |
| No. of Residential | 286 | 0 | 0 | 0 | 114 | 171 |
| Value of Residential | 104,469,790 | 0 | 0 | 0 | 41,787,916 | 62,681,874 |
| | | | | | | |
| % of Commercial | 13% | 0 | 0 | 0 | 20% | 80% |
| No. of Commercial | 10 | 0 | 0 | 0 | 2 | 8 |
| Value of Commercial | 43,193,847 | 0 | 0 | 0 | 8,638,769 | 34,555,077 |

## Critical Facilities

Tables 4.59 through 4.61 highlights the results of the vulnerability assessment of each state-owned or operated facility to the Tsunami hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

**TABLE 4.59** ***Estimated Tsunami Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 5 | 4 | | | | 1 | 12,727,552 |
| Fire Stations | 5 | 3 | | | | 2 | 7,792,547 |
| Emergency Response | 1 | 1 | | | | | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | 4 | | | | 1 | 95,838,253 |
| Government Buildings | 11 | 4 | | | | 7 | 118,417,923 |
| Shelters | 5 | 5 | | | | | 123,556,219 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 4 | 1 | | | | 3 | 26,038,712 |
| Airport | 1 | 1 | | | | | 22,475,260 |
| Utilities | | | | | | | |
| Electrical Power Plant | 1 | | | | | 1 | 51,172,046 |
| Sewage Treatment Plant | 1 | | 1 | | | | 61,792,356 |
| Water Treatment Plant | 1 | | 1 | | | | |
| WAPA Tanks | 1 | | 1 | | | | |
| Pumping Station | 1 | | 1 | | | | |
| | | | | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**<u>TABLE 4.60</u> *Estimated Tsunami Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 6 | 6 | | | | | 63,719,946 |
| Fire Stations | 5 | 5 | | | | | 9,269,808 |
| Emergency Response | 1 | 1 | | | | | - |
| Hospital/ Medical Clinic | 3 | 2 | | | | 1 | 135,990,389 |
| Government Buildings | 12 | 11 | | | | 1 | 121,046,648 |
| Shelters/Special Needs | 11 | 11 | | | | | 173,286,506 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 5 | 1 | | | | 4 | 9,922,078 |
| Airport | 1 | | | | | 1 | 57,686,500 |
| Utilities | | | | | | | |
| Electrical Power Plant | 1 | 1 | | | | | 51,917,850 |
| Sewage Pumps | 14 | 14 | | | | | 110,067,300 |
| Wastewater Treatment Plant | 1 | | | | | 1 | |
| Water Treatment Plant | 1 | 1 | | | | | |
| Water Pumps | 8 | 7 | | | | | |
| | | | | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.61** ***Estimated Tsunami Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 2 | 1 | | | | 1 | 4,321,296 |
| Fire Stations | 2 | 1 | | | | 1 | 4,845,666 |
| Emergency Response | 1 | 1 | | | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | 2 | | | | | 17,590,586 |
| Government Buildings | 3 | 3 | | | | | 13,159,486 |
| Shelters/Special Needs | 5 | 1 | | | | 1 | 52,473,202 |
| Transportation Infrastructure | | | | | | | - |
| Marine Ports | 1 | | | | | 1 | 2,884,325 |
| Airport | N/A | | | | | | |
| Utilities | | | | | | | - |
| Electrical Power Plant | 1 | | | | | 1 | 15,575,355 |
| WAPA Desalinization Plant | 1 | | | | | 1 | |
| WAPA Water Tank | 1 | | | | | 1 | |
| Sewage Treatment Plant | 1 | 1 | | | | | |
| Potable Water Tank | 1 | 1 | | | | | |
| | | | | | | | 33,518,154 |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

## 4.6.8 WILDFIRE

This section discusses the population and the proportion and value of buildings located in areas affected by a rain-induced landslides. It also provides an estimate of proportion of assets located in areas that are susceptible to rain-induced landslides

### Social Impacts

Table 4.62 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

**TABLE 4.62** ***Social Impacts (Wildfire)***

| Island Jurisdiction | Total Population | Less than 18 Years of Age in Hazard Area | % Less than 18 Years of Age in Hazard Area | Over 65 Years of Age in Hazard Area | % Over 65 Years of Age in Hazard Area |
|---|---|---|---|---|---|
| | | | | | |
| St. Thomas | 54,229 | 7,767 | 14% | 1,913 | 3.53% |
| | | | | | |
| St. Croix | 56,404 | 7,111 | 13% | 1,752 | 3.11% |
| | | | | | |
| St. John | 4,447 | 421 | 9% | 104 | 2.33% |

### Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings that are susceptible to this hazard. The findings of the vulnerability assessment for this Plan Update indicate that there are 10,067 residential structures and 219 commercial structures exposed to this hazard on St. Thomas. On St. Croix, there are 10,067 residential structures and 575 commercial structures exposed to this hazard on St. Thomas. On St. John, there are 831 residential structures and 35 commercial structures exposed to this hazard.

- On St. Thomas approximately 42% percent of the residential building stock and 35% of the commercial building stock is considered to be vulnerable wildfires. Of this percentage, approximately 32% of the residential building stock is of high vulnerability and the remaining 11% is of very high vulnerability to wildfires. Commercial structures are considered to be less vulnerable to wildfires with the majority of structures falling into the very low and low susceptibility categories.

- On St. Croix approximately 47% percent of the residential building stock susceptible to wildfire hazards. Of this percentage, approximately 26% of the residential building stock is of medium vulnerability, 30% of the residential building stock is of high vulnerability, and the remaining 16% is of very high vulnerability to wildfires. None of the commercial building inventory falls into the medium, high or very high vulnerability hazard rating for a rain-induced landslide.

- On St. John approximately 38% percent of the residential building stock and 44% of the commercial building stock is considered to be vulnerable to a wildfire. Of this percentage, approximately 18% of the residential building stock is of medium vulnerability, 30% of the residential building stock is of high vulnerability, and the remaining 8% is of very high vulnerability to wildfire hazard. None of the commercial building inventory is of medium high or very high vulnerability rating to a rain-induced landslide event.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

**TABLE 4.63 *Estimated Wildfire Exposure and Vulnerability (St. Thomas)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 42% | 18% | 17% | 22% | 32% | 11% |
| No. of Residential | 9813 | 1781 | 1694 | 2178 | 3099 | 1061 |
| Value of Residential | $2,699,517,976 | $489,938,678 | $466,103,823 | $599,108,197 | $852,463,874 | $291,903,404 |
| | | | | | | |
| % of Commercial | 35% | 51% | 49% | 0 | 0 | 0 |
| No. of Commercial | 774 | 398 | 376 | 0 | 0 | 0 |
| Value of Commercial | $644,801,763 | $331,612,335 | $313,189,428 | $0 | $0 | $0 |

**TABLE 4.64** ***Estimated Wildfire Exposure and Vulnerability (St. Croix)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 47% | 10% | 17% | 26% | 30% | 16% |
| No. of Residential | 10067 | 1,051 | 176 | 46 | 14 | 2 |
| Value of Residential | $2,723,994,577 | 284,286,019 | 47,720,282 | 12,397,796 | 3,762,452 | 618,913 |
| | | | | | | |
| % of Commercial | 27% | 37% | 63% | 0 | 0 | 0 |
| No. of Commercial | 590 | 219 | 138 | 0 | 0 | 0 |
| Value of Commercial | $389,185,044 | 144,142,609 | 90,756,458 | 0 | 0 | 0 |

**TABLE 4.65** ***Estimated Wildfire Exposure and Vulnerability (St. John)***

| Occupancy Class | Total Number of Buildings/ Percentage | Number, Percentage and Value of Buildings by Vulnerability Rating | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very high |
| % of Residential | 38% | 26% | 18% | 18% | 30% | 8% |
| No. of Residential | 854 | 223 | 154 | 153 | 259 | 65 |
| Value of Residential | $312,095,283 | 81,626,575 | 56,353,525 | 55,923,345 | 94,585,735 | 23,606,104 |
| | | | | | | |
| % of Commercial | 44% | 59% | 41% | 0 | 0 | 0 |
| No. of Commercial | 36 | 21 | 15 | 0 | 0 | 0 |
| Value of Commercial | $150,128,802 | 88,712,474 | 61,416,328 | 0 | 0 | 0 |

## Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

**TABLE 4.66 *Estimated Wildfire Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 5 | 1 | | | 4 | | 12,727,552 |
| Fire Stations | 5 | 1 | | 2 | 4 | | 7,792,547 |
| Emergency Response | 1 | 1 | | | | | 6,472,875 |
| Hospital, Clinics, and special needs | 5 | 4 | 1 | | 1 | | 95,838,253 |
| Government Buildings | 11 | 1 | | 1 | 10 | | 118,417,923 |
| Shelters | 5 | 4 | | 3 | 1 | | 123,556,219 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 4 | | | | 4 | | 26,038,712 |
| Airport | 1 | | | | 1 | | 22,475,260 |
| Utilities | | | | | | | |
| Electrical Power Generating Plants | 1 | 1 | | | | | 51,172,046 |
| Sewage Treatment Plant | 1 | | 1 | | | | 61,792,356 |
| Water Treatment Plant | 1 | | 1 | | | | |
| WAPA Tanks | 1 | 1 | | | | | |
| Pumping Station | 1 | | 1 | | | | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.67** ***Estimated Wildfire Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 6 | 3 | | 2 | 1 | | 63,719,946 |
| Fire Stations | 5 | 1 | | | | 4 | 9,269,808 |
| Emergency Response | N/A | | | | | | - |
| Hospital/ Medical Clinic | 3 | 2 | | 1 | | 1 | 135,990,389 |
| Government Buildings | 12 | 7 | | | | 5 | 121,046,648 |
| Shelters/Special Needs | 11 | 11 | | 3 | 8 | | 173,286,506 |
| Transportation Infrastructure | | | | | | | |
| Marine Ports | 5 | 5 | | | | | 9,922,078 |
| Airport | 1 | 1 | | | | | 57,686,500 |
| Utilities | | | | | | | |
| Electrical Power Generating Plants | 1 | 1 | | | | | 51,917,850 |
| Sewage Pumps | 14 | 9 | | 3 | 2 | 3 | 110,067,300 |
| Wastewater Treatment Plant | 1 | 1 | | | | 1 | |
| Water Treatment Plant | 1 | 1 | | | | | |
| Water Pumps | 8 | 3 | | 3 | 2 | 3 | |
| | | | | | | | |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

**TABLE 4.68** ***Estimated Wildfire Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

| Facility | # of Facilities in Class | Vulnerability Rating | | | | | Total Exposure |
|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High | |
| | | | | | | | |
| Critical Facilities | | | | | | | |
| Police Stations | 2 | | | | 2 | | 4,321,296 |
| Fire Stations | 2 | 1 | | | 1 | | 4,845,666 |
| Emergency Response | 1 | 1 | | | | | 5,142,339 |
| Hospital/ Medical Clinic | 2 | 1 | | | | | 17,590,586 |
| Government Buildings | 3 | | | | 3 | | 13,159,486 |
| Shelters/Special Needs | 5 | 3 | | | 2 | | 52,473,202 |
| Transportation Infrastructure | | | | | | | - |
| Marine Ports | 1 | 1 | | | | | 2,884,325 |
| Airport | N/A | | | | | | |
| Utilities | | | | | | | - |
| Electrical Power Generating Plants | 1 | | | | | 1 | 15,575,355 |
| WAPA Desalinization Plant | 1 | | | | | 1 | |
| WAPA Water Tank | 1 | | | | | 1 | |
| Sewage Treatment Plant | 1 | | | | | 1 | |
| Potable Water Tank | 1 | | | | | 1 | 33,518,154 |

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

## 4.7 LOSS ESTIMATES

This section of the Plan Update presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed on a hazard-by-hazard basis. The findings support local and regional planners' understanding of the potential impacts of each hazard and enable a comparison of hazards by quantifying potential exposures impacts.

The loss estimates provided in this section were developed using available data, and the methodologies applied have resulted in an approximation of risk. These estimates should be used to understand relative risk from hazards and potential losses.

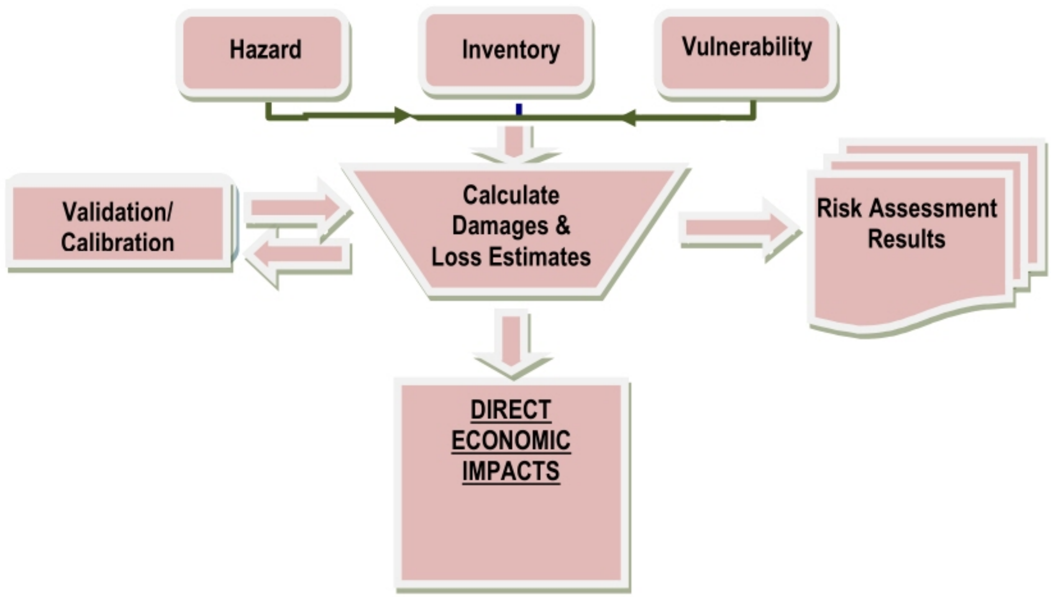
However, it is important to understand that uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis.

The risk assessment utilized for this Plan Update was parametric. The risk analyses are based on a comprehensive methodology that incorporates approaches for:

- Characterizing Hazards, understanding the nature of the hazards (i.e. level of ground shaking, wind speed, depth of flooding);
- Categorization of the built environment, understanding number, distribution, and value of assets (i.e. general buildings & critical facilities),
- Vulnerability Analysis, understanding the damage and loss characteristics of identified buildings, and
- Estimating damage and losses to buildings and critical facilities.

Figure 4.26 illustrates a conceptual model of the loss estimation methodology as applied for the US Virgin Islands Mitigation Plan.

**FIGURE 4.26** ***Conceptual Model of Risk Assessment Methodology***




For each of the hazards (Earthquake, Riverine Flooding, Coastal Flooding, Hurricane Winds, and Tsunami) estimates were derived from calculating the number of buildings exposed to the hazard and the potential economic losses. The economic loss ratio is also provided, which is the percentage of the losses against the total value of all the structures within the Territory for a particular hazard.

Loss estimates associated with drought were not analyzed using a risk assessment methodology based on the same principals as described above. Instead, available historical data for each hazard are used and statistical evaluations are performed using manual calculations. The general steps used in this methodology are summarized below:

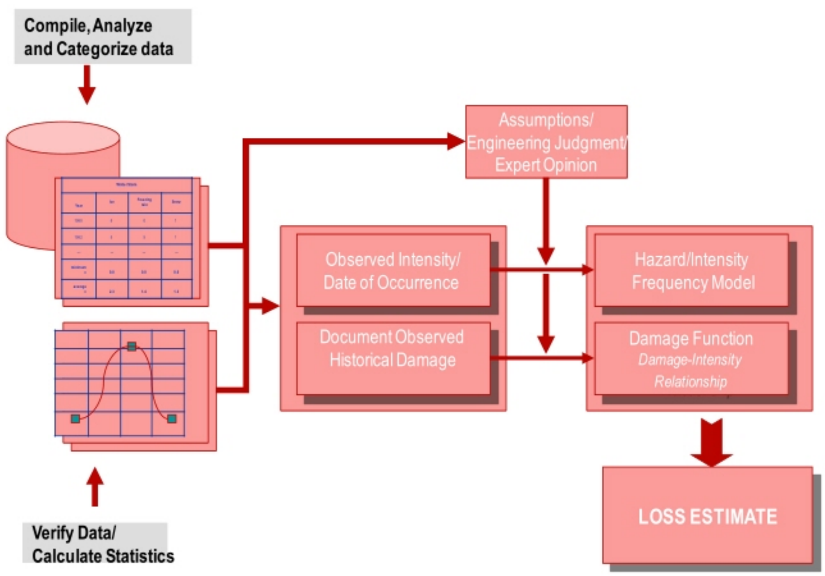
- Compile and analyze available data from national and local sources
- Verify data and conduct statistical analysis to relate historical patterns within the data to existing hazard models
- Develop model parameters based on data analysis, existing hazard models, and risk engineering judgment

The paucity of historic information that was available for these hazards necessitated the CIPA consultant team to try to ascertain the following:

- Analysis of frequency of hazard occurrence
- Analysis of intensity and/or damages parameters associated with hazard occurrence (for example, one drought event = $ in estimated damages)
- Development of frequency curves expected damages
- Estimate losses

Figure 4.27 illustrates a conceptual model of the statistical risk assessment methodology as applied to the US Virgin Islands.

**FIGURE 4.27:** ***Conceptual Model of Statistical Risk Assessment Methodology***




The risk assessment methodologies used in the Plan Update are standardized, meaning they have been applied to each island in the same way. Impacts presented in this study include only direct social economic losses because of data limitations and time constraints on the project; however these results represent the key impacts faced by US Virgin Islands.

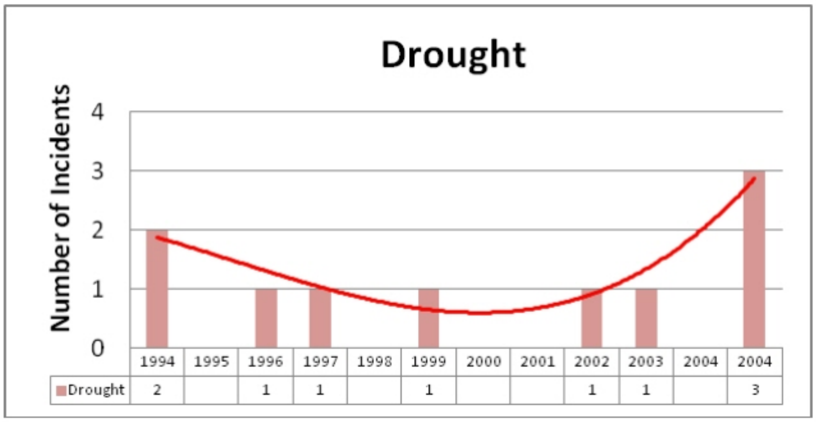
## 4.7.1 DROUGHT

This subsection of the risk assessment presents the "estimate of losses for drought hazard.

### Estimated Losses: Economic Impact

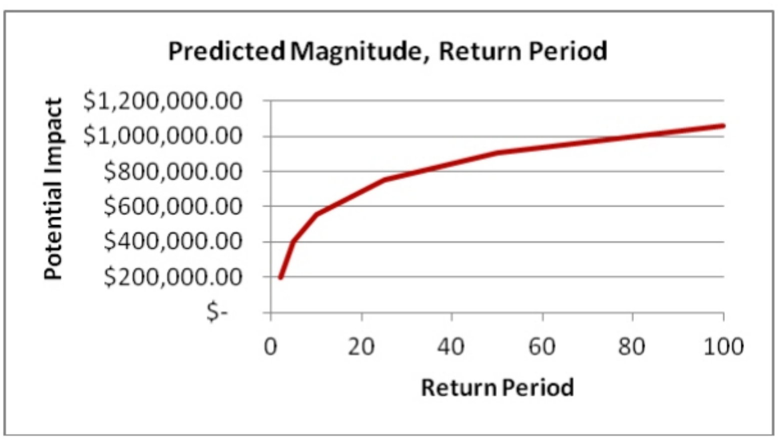
Estimated losses for drought were aggregated for primary economic impacts that could impact the US Virgin Islands through regional economic loss. The primary economic impact was assumed to be increased costs associated with feeding cattle.

**FIGURE 4.28** ***Historical Droughts in US Virgin Islands, 2003-2007***




This figure was based regional historic drought data for Puerto Rico and the US Virgin Islands. Based on the available data and the assumptions provided above, the predicted impact of a drought with a 50% probability of occurrence is $200,000.

**FIGURE 4.29** ***Historical Droughts in US Virgin Islands, 2003-2007***




The expected impact of a drought for a 100 year return period is approximately 1.058M. Damage parameters from only two (2) historic events in the US Virgin Islands were used to develop this estimate.

## 4.7.2 EARTHQUAKE

This subsection of the risk assessment presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed for the earthquake hazard.

### Estimated Losses: General Building Stock

Damages and losses were estimated based on a 1000-year probabilistic ground shaking scenario. Property damage is summarized by general occupancy classes. The total damage for a 1000-year event was estimated to be $6 billion for St. Thomas, $4.3 billion for St. Croix and $463 million for St. John. This represents a $419 billion increase in estimated losses for on St. Thomas since the 2011 Plan. Estimated losses for St. Croix have increased by 11M and 9.7 M on St. John.

**TABLE 4.69** ***Estimated Losses: General Building Stock for Earthquake Hazard***

| Occupancy | No of Affected Buildings | Expected Losses | % Value |
|---|---|---|---|
| St. Thomas | | | |
| Residential | 21,679 | $ 4,641,269,145 | 72% |
| Commercial | 981 | $ 1,384,710,463 | 86% |
| Total | 22,660 | $ 6,025,979,608 | |
| St. Croix | | | |
| Residential | 18,082 | $ 3,645,930,917 | 56% |
| Commercial | 670 | $ 746,489,600 | 53% |
| Total | 18,753 | $ 4,392,420,517 | |
| St. John | | | |
| Residential | 1,431 | $ 386,386,207 | 0.54 |
| Commercial | 70 | $ 76,830,370 | 0.65 |
| Total | 1,501 | $ 463,216,578 | |

## Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.70.

**TABLE 4.70 *Estimated Losses: Critical Facilities and Infrastructure for Earthquake Hazard***

| Facility | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| | | | |
| Critical Facilities | | | |
| Police Stations | $13,804,002 | $42,949,130 | $2,373,142 |
| Fire Stations | $32,370,825 | $7,431,814 | $3,321,795 |
| Emergency Response | $6,331,171 | $2,476,394 | $3,367,056 |
| Hospital/ Medical Clinic | $71,272,393 | $106,217,486 | $9,393,598 |
| Government Buildings | $103,612,740 | $109,157,907 | $8,777,514 |
| Shelters/Special Needs | $123,062,681 | $128,181,063 | $54,803,795 |
| Transportation Infrastructure | | | |
| Marine Ports | $6,844,012 | $364,105 | $33,953 |
| Airport | $26,632 | $30,627,988 | $0 |
| Utilities | | | |
| Electrical Power Generating Plants | $30,892,492 | $43,768,184 | $14,094,331 |
| Water Treatment Plants | $44,509,147 | $15,989,798 | $2,096,480 |
| Wastewater Treatment Plants | $910,804 | $16,707,348 | $20,768,378 |
| Pumps | $295,361 | $16,476,882 | -- |
| Tanks | $8,080,947 | $8,451,850 | $1,090,889 |

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

## 4.7.3 RIVERINE FLOODING

This subsection of the risk assessment presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed for the riverine flooding hazard.

### Estimated Losses: General Building Stock

Property damage due to the riverine hazard is summarized in Table 4.71 by occupancy class. The total expected loss for a 100-year MRP is approximately $1B million for St. Thomas, $768 million for St. Croix and $17million for St. John. This represents a significant increase for the Territory.

**TABLE 4.71** ***Estimated Losses: General Building Stock for Riverine Flooding Hazard***

| Occupancy | No of Affected Buildings | Expected Losses | % Value |
|---|---|---|---|
| | | | |
| St. Thomas | | | |
| Residential | 11,390 | $ 752,430,862 | 0.12 |
| Commercial | 742 | $ 292,639,745 | 0.18 |
| Total | 12,133 | $ 1,045,070,607 | |
| St. Croix | | | |
| Residential | 4,648 | $ 618,081,641 | 0.09 |
| Commercial | 349 | $ 150,076,139 | 0.11 |
| Total | 4,996 | $ 768,157,780 | |
| St. John | | | |
| Residential | 309 | $ 15,718,980 | 0.02 |
| Commercial | 9 | $ 1,570,220 | 0.01 |
| Total | 318 | $ 17,289,200 | |

The estimated loss values are based on the count of buildings damaged as presented in the table above. Building counts are based on a geographic distribution of structures by occupancy class across estate boundaries.

## Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.72.

**TABLE 4.72** ***Estimated Losses: Critical Facilities and Infrastructure for Riverine Flooding Hazard***

| Facility | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| | | | |
| Critical Facilities | | | |
| Police Stations | $2,208,247 | $846,102 | $2,450,885 |
| Fire Stations | $32,635,564 | $0 | $0 |
| Emergency Response | $0 | $0 | $0 |
| Hospital/ Medical Clinic | $4,495,220 | $0 | $0 |
| Government Buildings | $81,303,611 | $41,134,403 | $6,613,182 |
| Shelters/Special Needs | $55,258,961 | $8,146,920 | $24,107,203 |
| Transportation Infrastructure | $0 | $0 | $0 |
| Marine Ports | $2,143,620 | $0 | $34,183 |
| Airport | $0 | $0 | $0 |
| Utilities | $0 | $0 | $0 |
| Electrical Power Generating Plants | $0 | $0 | $2,768,783 |
| Water Treatment Plants | $44,437,250 | $9,229,275 | $0 |
| Wastewater Treatment Plants | $937,800 | $0 | $22,218,625 |
| Pumps | $0 | $1,525,473 | -- |
| Tanks | $0 | $517,334 | $0 |
| | | | |

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

## 4.7.4 Coastal Flooding

This subsection of the risk assessment presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed for the coastal flooding hazard.

### Estimated Losses: General Building Stock

The total estimated property damages and losses for a Category 5 Storm Surge event is $171 million for St. Thomas, $78.5 million for St. Croix and $26.6 million for St. John. Table 4.48 presents these results by occupancy class. This represents a $439 million increase in estimated losses for the Territory since the 2011 Plan.

**TABLE 4.73** ***Estimated Losses: General Building Stock for Coastal Flooding Hazard***

| Occupancy | No of Affected Buildings | Expected Losses | % Value |
|---|---|---|---|
| | | | |
| St. Thomas | | | |
| Residential | 1,511 | $ 115,105,946 | 0.02 |
| Commercial | 236 | $ 56,606,106 | 0.04 |
| Total | 1,747 | $ 171,712,053 | |
| St. Croix | | | |
| Residential | 3,425 | $ 52,319,194 | 0.01 |
| Commercial | 334 | $ 26,256,719 | 0.02 |
| Total | 3,760 | $ 78,575,913 | |
| St. John | | | |
| Residential | 386 | $ 22,500,497 | 0.03 |
| Commercial | 3 | $ 4,123,048 | 0.03 |
| Total | 389 | $ 26,623,544 | |

The estimated loss values are based on the count of buildings damaged as presented in the table above. Building counts are based on a geographic distribution of structures by occupancy class across estate boundaries.

## Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.74.

**TABLE 4.74** ***Estimated Losses: Critical Facilities and Infrastructure For Coastal Flooding Hazard***

| Facility | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| | | | |
| Critical Facilities | | | |
| Police Stations | $133,178 | $0 | $0 |
| Fire Stations | $13,900,517 | $0 | $0 |
| Emergency Response | $0 | $0 | $0 |
| Hospital/ Medical Clinic | $3,196,231 | $0 | $0 |
| Government Buildings | $6,455,387 | $3,987,047 | $9,113,250 |
| Shelters/Special Needs | $0 | $0 | $0 |
| Transportation Infrastructure | $0 | $0 | $0 |
| Marine Ports | $2,774,553 | $2,871,330 | $102,548 |
| Airport | $0 | $0 | $0 |
| Utilities | $0 | $0 | $0 |
| Electrical Power Generating Plants | $13,317,856 | $0 | $14,766,840 |
| Water Treatment Plants | $0 | $9,844,560 | $0 |
| Wastewater Treatment Plants | $17,091,250 | $0 | $29,055,125 |
| Pumps | $0 | $379,623 | -- |
| Tanks | $0 | $162,591 | $1,296,013 |

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

## 4.7.5 HURRICANE WIND

This subsection of the risk assessment presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed for the hurricane wind hazard.

### Estimated Losses: General Building Stock

Property damage due to the wind-hurricane hazard is summarized in Table 4.73 by occupancy class. The total expected for a loss for a hurricane event with a 50 year MRP is approximately $3.6 billion for St. Thomas, $1.8 billion for St. Croix and $190 million for St. John. This represents an increase of $2.3 billion in the Territory since the 2011 Plan.

**TABLE 4.75** ***Estimated Losses: General Building Stock for Hurricane Wind Hazard***

| Occupancy | No of Affected Buildings | Expected Losses | % Value |
|---|---|---|---|
| | | | |
| St. Thomas | | | |
| Residential | 14,184 | $ 3,097,521,815 | 0.48 |
| Commercial | 856 | $ 571,109,732 | 0.36 |
| Total | 15,041 | $ 3,668,631,547 | |
| St. Croix | | | |
| Residential | 12,986 | $ 1,508,195,711 | 0.23 |
| Commercial | 555 | $ 307,082,553 | 0.22 |
| Total | 13,542 | $ 1,815,278,264 | |
| St. John | | | |
| Residential | 745 | $ 163,596,725 | 0.23 |
| Commercial | 32 | $ 26,457,092 | 0.22 |
| Total | 777 | $ 190,053,817 | |

Because of differences in building construction, residential structures are more susceptible to wind damage. In using the damage counts for buildings, the number of buildings impacted should be interpreted loosely. Damage to a specific building can range from slight damage to total destruction; the total dollar damage estimates the overall impact to individual buildings at an aggregate level. The increase in construction cost, both commercial and residential, have increased the value of the building stock and thus estimated losses.

## Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.76.

**TABLE 4.76** ***Estimated Losses: Critical Facilities and Infrastructure for Hurricane Wind Hazard***

| Facility | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| | | | |
| Critical Facilities | | | |
| Police Stations | $8,455,970 | $28,488,869 | $1,783,516 |
| Fire Stations | $30,035,180 | $6,495,932 | $2,481,830 |
| Emergency Response | $3,402,979 | $1,462,893 | $1,899,208 |
| Hospital/ Medical Clinic | $50,949,906 | $94,355,181 | $8,595,732 |
| Government Buildings | $84,600,149 | $80,955,418 | $5,960,850 |
| Shelters/Special Needs | $83,389,427 | $102,857,136 | $41,504,841 |
| Transportation Infrastructure | $0 | $0 | $0 |
| Marine Ports | $10,007,260 | $750,907 | $90,909 |
| Airport | $9,924,923 | $28,222,427 | n/a |
| Utilities | $0 | $0 | $0 |
| Electrical Power Generating Plants | $10,839,286 | $23,936,125 | $5,266,686 |
| Water Treatment Plants | $19,565,950 | $23,936,125 | $1,287,957 |
| Wastewater Treatment Plants | $364,269 | $9,267,130 | $9,494,825 |
| Pumps | $110,851 | $6,865,235 | -- |
| Tanks | $2,998,359 | $2,084,234 | $591,014 |

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

### 4.7.6 RAIN-INDUCED LANDSLIDE

A deterministic approach was used to address the rain induced landslide hazard based on a worst-case scenario that assumed extensive to complete damage of structures during a landslide event.

Probability was not assigned to the rain-induced landslide hazard. Limited data and time needed to perform detailed mapping and statistical analysis go well beyond the scope of this study effort. The primary economic impact was assumed to be costs associated with infrastructure repair.

Based on the available data and the assumptions provided above, estimated impact of a rain-induced landslide is approximately $500,000. Damage parameters from historic events in the US Virgin Islands were used to develop this estimate.

## Estimated Losses: General Building Stock

The physical damage that could occur as a result of rain-induced landslide is summarized in Table 4.77. Estimated property damages and losses for the landslide hazard were aggregated across occupancy classes and are estimated to be $76 million for St. Thomas, $20 million for St. Croix and $21 million for St. John.

**TABLE 4.77** ***Estimated Losses: General Building Stock for Rain-Induced landslide Hazard***

| Occupancy | No of Affected Buildings | Expected Losses | % Value |
|---|---|---|---|
| St. Thomas | | | |
| Residential | 4,169 | 76,647,667 | 0.01 |
| Commercial | 0 | $ - | 0.00 |
| Total | 4,169 | $ 76,647,667 | |
| St. Croix | | | |
| Residential | 1,209 | $ 20,892,953 | 0.004 |
| Commercial | 0 | $ - | 0.00 |
| Total | 1,328 | $ 20,892,953 | |
| St. John | | | |
| Residential | 455 | $ 21,247,859 | 0.03 |
| Commercial | 0 | $ - | 0.00 |
| Total | 535 | $ 21,247,859 | |

## Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.78.

**TABLE 4.78** ***Estimated Losses: Critical Facilities and Infrastructure for Rain-induced Landslide Hazard***

| Facility | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| | | | |
| Critical Facilities | | | |
| Police Stations | $0 | $0 | $0 |
| Fire Stations | $0 | $0 | $0 |
| Emergency Response | $0 | $0 | $0 |
| Hospital/ Medical Clinic | $2,260,000 | $0 | $0 |
| Government Buildings | $0 | $0 | $0 |
| Shelters/Special Needs | $20,893,076 | $0 | $0 |
| Transportation Infrastructure | | | |
| Marine Ports | $0 | $0 | $0 |
| Airport | $0 | $0 | $0 |
| Utilities | | | |
| Electrical Power Generating Plants | $0 | $0 | $0 |
| Water Treatment Plants | $0 | $0 | $0 |
| Wastewater Treatment Plants | $0 | $0 | $0 |
| Pumps | $0 | $0 | -- |
| Tanks | $0 | $0 | $0 |

## 4.7.7 TSUNAMI

### Estimated Losses: General Building Stock

A deterministic approach was used to address the tsunami hazard based on a worst-case scenario that assumed extensive to complete damage within the Tsunami inundation area. Probability was not assigned to the tsunami hazard. Limited data and time needed to perform statistical analysis go well beyond the scope of this study effort. Therefore, while total damages were estimated, a return period is not applicable for the Tsunami hazard. The physical damage that could occur as a result of Tsunami is summarized in Table 4.76. Estimated property damages and losses for the tsunami hazard were aggregated across occupancy classes and are estimated to be $1.2 billion for St. Thomas, $786 million for St. Croix and $114 million for St. John. This represents a $234 million increase in estimated losses for on the Territory since the 2011 Plan.

**TABLE 4.79** ***Estimated Losses: General Building Stock for Tsunami Hazard***

| Hazard | No of Affected Buildings | Expected Losses | % Value |
|---|---|---|---|
| | | | |
| St. Thomas | | | |
| Residential | 4,417 | $ 808,769,974 | 0.19 |
| Commercial | 376 | $ 402,633,004 | 0.38 |
| Total | 4,793 | $ 1,211,402,978 | |
| St. Croix | | | |
| Residential | 2,961 | $ 524,598,730 | 0.13 |
| Commercial | 258 | $ 261,998,197 | 0.30 |
| Total | 3,218 | $ 786,596,927 | |
| St. John | | | |
| Residential | 833 | $ 96,449,264 | 0.19 |
| Commercial | 35 | $ 18,284,842 | 0.21 |
| Total | 868 | $ 114,734,106 | |

## Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.80.

**TABLE 4.80 *Estimated Losses: Critical Facilities and Infrastructure for Tsunami Hazard***

| Facility | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| | | | |
| Critical Facilities | | | |
| Police Stations | $532,714 | $0 | $1,036,413 |
| Fire Stations | $54,003,910 | $0 | $1,171,972 |
| Emergency Response | $0 | $0 | $0 |
| Hospital/ Medical Clinic | $11,762,331 | $26,441,762 | $0 |
| Government Buildings | $98,704,238 | $4,208,549 | $15,003,849 |
| Shelters/Special Needs | $0 | $0 | $13,348,261 |
| Transportation Infrastructure | | | |
| Marine Ports | $11,098,214 | $8,251,656 | $290,551 |
| Airport | $0 | $61,528,500 | $0 |
| Utilities | | | |
| Electrical Power Generating Plants | $49,720,000 | $50,850,000 | $18,458,550 |
| Water Treatment Plants | $68,365,000 | $18,458,550 | $3,586,232 |
| Wastewater Treatment Plants | $1,442,768 | $27,346,000 | $0 |
| Pumps | $0 | $663,030 | -- |
| Tanks | $0 | $258,667 | $1,472,742 |

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

## 4.7.8 WILDFIRE

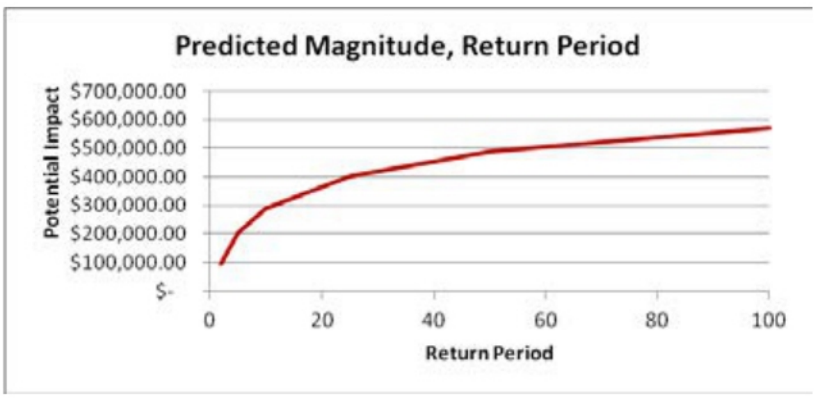
This subsection of the risk assessment presents the "estimate of losses for wildfires. Estimated losses for wildfires were aggregated for primary economic impacts that could impact the US Virgin Islands through economic loss.

### Estimated Losses: Economic Impact

Estimated losses for drought were aggregated for primary economic impacts that could impact the US Virgin Islands through regional economic loss. The primary economic impact was assumed to be increased costs associated with feeding cattle.

This figure was based regional historic drought data for the US Virgin Islands. Based on the available data and the assumptions provided above, the predicted impact of a drought with a 50% probability of occurrence is $93,500,000 and a 1% occurrence of experiencing a wildfire event of $570,000.00.

**FIGURE 4.29** ***Historical Wildfire in US Virgin Islands, 2000-2010***




The expected impact of a drought for a 100 year return period is approximately 570,000.00. Damage parameters from seventeen (17) events historic events in the US Virgin Islands were used to develop this estimate.

## 4.8 LOSS ESTIMATION SUMMARY AND HAZARD RANKING

This section of the Plan Update, presents a summary of the loss estimates similar to that included in the 2011 Plan. This section is used to evaluate the risk between hazards facing USVI. To do so, one must understand that the risk from a hazard is relative to its return period. For the purposes of risk assessment, a return period has been selected for each hazard analysis.

To assist in evaluating the results of this study, a simple ranking methodology has been developed based on a comparison of the losses per year (i.e. aggregate losses/ return period) and the expected period of recovery following the hazard events considered for this study. Table 4.81 represents hazards that are a more pressing concern to the territory. This ranking provides information on hazards that the territory should focus on (i.e. hazards that require aggressive correction of deficiencies with community funding). This ranking is based on an expected loss per year for each hazard, simply calculated as the total expected losses (critical facilities, commercial and residential) divided by the Return Period of the selected event, representing the amount of capital the territory would have to set aside to cover the damages for such an event.

**TABLE 4.81** ***Hazard-by-Hazard Summary of Loss Estimates for US Virgin Islands***

| Hazard | Return Period (Years) | Critical Facility Losses | Residential Losses | Commercial Losses | Total Loss | Loss/Year |
|---|---|---|---|---|---|---|
| **St. Thomas** | | | | | | |
| Drought | 100 | N/A | N/A | N/A | $ 1,058,989.77 | $ 10,590 |
| Earthquake | 1000 | $ 442,013,206 | $ 4,641,269,145 | $ 1,384,710,463 | $ 6,467,992,814 | $ 6,467,993 |
| Riverine Flooding | 100 | $ 223,420,272 | $ 752,430,862 | $ 292,639,745 | $ 1,268,490,879 | $ 12,684,909 |
| Coastal Flooding | 120 | $ 56,868,971 | $ 115,105,946 | $ 56,606,106 | $ 228,581,024 | $ 1,904,842 |
| Hurricane | 50 | $ 314,644,509 | $ 3,097,521,815 | $ 571,109,732 | $ 3,983,276,056 | $ 79,665,521 |
| Rain-Induced Landslide | 50 | $ 23,153,076 | $ 76,647,667 | $ - | $ 99,800,743 | $ 1,996,015 |
| Tsunami | 500 | $ 295,629,176 | $ 808,769,974 | $ 402,633,004 | $ 1,507,032,154 | $ 3,014,064 |
| Wildfire | 10 | | | | $ 571,815 | $ 57,181 |
| | | | | | | |
| **St. Croix** | | | | | | |
| Drought | 100 | N/A | N/A | N/A | $ 1,058,989.77 | $ 10,590 |
| Earthquake | 1000 | $ 528,799,950 | $ 3,645,930,917 | $ 746,489,600 | $ 4,921,220,467 | $ 4,921,220 |
| Riverine Flooding | 100 | $ 61,399,508 | $ 618,081,641 | $ 150,076,139 | $ 829,557,287 | $ 8,295,573 |
| Coastal Flooding | 120 | $ 17,245,151 | $ 52,319,194 | $ 26,256,719 | $ 95,821,063 | $ 798,509 |
| Hurricane | 50 | $ 409,677,613 | $ 1,508,195,711 | $ 307,082,553 | $ 2,224,955,877 | $ 44,499,118 |
| Rain-Induced Landslide | 50 | $ - | $ 20,892,953 | $ - | $ 20,892,953 | $ 417,859 |
| Tsunami | 500 | $ 198,006,714 | $ 524,598,730 | $ 261,998,197 | $ 984,603,641 | $ 1,969,207 |
| Wildfire | 10 | | | | $ 571,815 | $ 57,181 |
| | | | | | | |
| **St. John** | | | | | | |
| Drought | 100 | N/A | N/A | N/A | $ 1,058,989.77 | $ 10,590 |
| Earthquake | 1000 | $ 120,120,930 | $ 444,103,045 | $ 88,306,986 | $ 652,530,961 | $ 652,531 |
| Riverine Flooding | 100 | $ 58,192,860 | $ 18,067,019 | $ 1,804,774 | $ 78,064,652 | $ 780,647 |
| Coastal Flooding | 120 | $ 54,333,776 | $ 25,861,531 | $ 4,738,932 | $ 84,934,239 | $ 707,785 |
| Hurricane | 50 | $ 78,957,369 | $ 188,034,154 | $ 30,409,148 | $ 297,400,671 | $ 5,948,013 |
| Rain-Induced Landslide | 50 | $ - | $ 21,247,859 | $ - | $ 21,247,859 | $ 424,957 |
| Tsunami | 500 | $ 54,368,571 | $ 96,449,264 | $ 18,284,842 | $ 169,102,677 | $ 338,205 |
| Wildfire | 10 | | | | $ 571,815 | $ 57,181 |

This ranking mechanism allows not only a ranking for each hazard, but a weight factor for each hazard to compare the relative economic losses to the community The expected loss per year of Return Period can allow each jurisdiction individually to prioritize their hazards on an individual basis, and also allows the territory as a whole to determine which hazard most affects them as a whole.

The Recovery Ranking Table was not developed for this Plan Update. The paucity of data for certain hazards would lead to inclusive findings and would be misleading to gauge recovery efforts. Instead the potential dollar loss rankings are summarized in Table 4.82. It shows that the dollar loss for the VI as a whole is greatest for hurricanes and wildfires.

**TABLE 4.82** ***Summary of Hazard Rankings for USVI***

| Hazard | St. Thomas | St. Croix | St. John |
|---|---|---|---|
| Drought | 8 | 8 | 8 |
| Earthquake | 3 | 3 | 4 |
| Riverine Flooding | 2 | 2 | 2 |
| Coastal Flooding | 5 | 5 | 3 |
| Hurricane | 1 | 1 | 1 |
| Rain-Induced Landslide | 6 | 6 | 5 |
| Tsunami | 4 | 4 | 6 |
| Wildfire | 7 | 7 | 7 |
| | | | |

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Section Five is divided into the following seven subsections:

- 5.1 IFR Requirement for Mitigation Strategy
- 5.2 Summary of the Risk and Capability Assessment
- 5.3 Analysis of Mitigation Strategy
- 5.4 Goals and Objectives
- 5.5 Identification of Mitigation Actions
- 5.6 Evaluation and Prioritization of Mitigation Actions
- 5.7 Implementation of Actions

# 5.1 IFR REQUIREMENT FOR MITIGATION STRATEGY

Section §201.4(c)(3) of the IFR states that "[to be effective, the plan must include] the State's blueprint for reducing the losses identified in the risk assessment."

The IFR includes three specific requirements that relate to the development of a Mitigation Strategy for the US Virgin Islands:

- **Hazard Mitigation Goals per Requirement §201.4(c)(3)(i):** "[The State shall include a] description of State goals to guide the selection of activities to mitigate and reduce potential losses."
- **Mitigation Actions** per **Requirement §201.4(c)(3)(iii):** **"**[State plans shall include an] identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy."
- **Funding Sources** per **Requirement §201.4(c)(3)(iv):** **"**[The State mitigation strategy shall include an] identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities."

# 5.2 SUMMARY OF THE RISK AND CAPABILITY ASSESSMENT

## 5.2.1 SUMMARY OF RISK ASSESSMENT

The overall risk assessment methodology utilized in this Plan Update is the same that as was utilized in the 2011 Plan. It is consistent with the process and steps presented in FEMA Publication 386-2, "State and Local Mitigation Planning How-To Guide, Understanding Your Risks—Identifying Hazards and Estimating Losses" (FEMA 2001) and utilizes a risk assessment methodology similar to HAZUS-MH.

The results of the hazard identification process and discussions with VITEMA, which held a series of meetings with the Island Hazard Mitigation Committees prior to the consultant team being contracted to develop the plan, indicated that there were not any new hazards that needed to be considered in this Plan Update. Therefore, the hazards addressed in the 2014 plan Update are the same that were addressed in the 2011 Plan. It should be noted that data sets for conducting vulnerability assessments for all of the hazards were not readily available (frequency of occurrence; magnitude and damages associated with historical events) so that the losses were estimated in a deterministic manner so as to arrive at the worst case scenario loss estimates for wildfire, landslide and drought.

Similar to the 2011 plan, the lack of accurate historical data prevented the CIPA consultant team from conducting a detailed and verifiable assessment for these hazards and necessitated using different estimation techniques. Hazard overlays were performed to identify the number of buildings in hazard susceptibility zones identified on newly created maps for these hazards. Hence, the vulnerability assessments for the new hazards provide only a rough estimate of the built environment that is exposed to these hazards.

A summary of the findings of the Risk Assessment for the 2014 Plan Update were presented to VITEMA at a meeting on May 13, 2014 and subsequently to the Island Hazard Mitigation Committees on May 13, 14, and 15, 2014. The risk assessment served as a foundation for the deliberations of the Committees in formulating a mitigation strategy for this Plan Update.

As a result of variation in values of Real Property over the past three years the Estimated Losses that would occur as a result of natural hazard events also fluctuated. To illustrate the impact that the reevaluation of the property values has upon the Loss Estimates the following matrix is provided. Table 5.1 demonstrates the differences in the Loss Estimates between the 2011 Plan and the 2014 Plan Update. A summary is provided for each major island in the Territory. The values presented in this matrix are painted in broad strokes with the intent to furnish a synopsis only of the changes in estimated losses included in this Plan Update.

**TABLE 5.1** ***Hazard-by-Hazard Comparison of Loss Estimates of 2011 Plan and 2014 Plan Update***

| | 2011 Plan Update | 2014 Plan Update | Difference (+ / -) |
|---|---|---|---|
| **St. Thomas** | | | |
| Drought | N/A | 1.058M | 1.058M |
| Earthquake | 5.7B | 6.4B | .7B |
| Riverine Flooding | 1.1B | 1.2B | 419.1M |
| Coastal Flooding | 203M | 228M | 25M |
| Hurricane | 3.5B | 3.9B | .4B |
| Rain-Induced Landslide | 1.3B | 1.9M | -1.2B |
| Tsunami | 1.3B | 1.5B | .2B |
| Wildfire | 637M | .5M | -636M |
| **St. Croix** | | | |
| Drought | N/A | 1.058M | 1.058M |
| Earthquake | 4.8B | 4.9B | .1B |
| Riverine Flooding | 818M | 829M | 11M |
| Coastal Flooding | 92M | 95M | 3M |
| Hurricane | 2.1B | 2.2B | .1B |
| Rain-Induced Landslide | 208M | 20.9M | -187M |
| Tsunami | 959M | 984M | 25M |
| Wildfire | 146M | .5M | -145M |
| **St. John** | | | |
| Drought | N/A | 1.058M | 1.058M |
| Earthquake | 562.4M | 583M | 21M |

| | | | |
|---|---|---|---|
| Riverine Flooding | 65.3M | 75M | 9.7M |
| Coastal Flooding | 71.5M | 80M | 8.5M |
| Hurricane | 255.3M | 269M | 14M |
| Rain-Induced Landslide | 123.2M | 21M | -121M |
| Tsunami | 144.7M | 154.1M | 6.4M |
| Wildfire | 71M | .5M | -70M |

The estimated losses presented above consider all vulnerable properties of the Territory, residential, commercial, and governmental critical facilities. The hazard mitigation strategy developed by the Island Mitigation Committees are congruent with the assessment of risk as detailed in Section Four of the this Plan Update. The Territorial Mitigation Strategy addresses the vulnerability of the building stock and critical facilities and infrastructure. The section of the Plan Update focuses on the potential risk of the Territory and presents a strategy for mitigating possible loss due to a hazard event as offered in the Risk Assessment providing a strong congruency between the two in this Plan Update.

## 5.2.2 CLIMATE CHANGE AND CLIMATE VARIABILITY

The implications of climate change variability on the small island states in the Caribbean will need to be thoroughly addressed in future Plan Updates. Some of those implications are discussed in a qualitative manner for specific hazards evaluated in Section 4 Risk Assessment. The challenge for the Territory is to integrate those findings into the hazard identification and risk assessment and make them relevant to the US Virgin Islands. Each island has its own climate, geology, topography, industries, and culture; particularly important are the differences between St. Thomas/St. John and the lower lying, less mountainous terrain on St. Croix. Still, some impacts of climate change could bring similar challenges to all three island communities of the USVI.

The vulnerability of the small island states in the Caribbean relate to their relative isolation, small land mass, concentrations of population and infrastructure in coastal areas and limited economic base with a reliance on tourism and natural resources. This vulnerability led to collaboration between regional academic and governmental institutions in 2004 with the creation of the Caribbean Community Climate Change (CCCCC) initiative. The research effort used global climate change models and down-scaled the analysis to create a regional climate change model for the Caribbean. The regional model (PRECIS) simulations suggest a significant reduction of mean annual rainfall (10 to 50 percent) by the end of the Century (Bulletin of the American Meteorological Society). Climate change will likely affect the availability of potable water on the Virgin Islands in the future. This finding will have implications not only for water availability but also to drought and wildfire hazards.

In the Caribbean, coral reefs provide annual benefits of more than $3 billon (USGCRP 2009). Coral reef systems already face serious impacts from sedimentation and water pollution; warmer, more acidic coastal waters would cause further stress to coral reefs. The loss and inundation of other coastal habitats from sea level rise and storm surge could endanger species that use these habitats for nesting, nursing, and feeding. Impacts to coastal resources would have serious implications to tourism, a key economic driver in the Virgin Islands. An analysis of the need to address global warming predicted that the cost of not taking action would reduce the GDP 6.7 percent by 2025 and 14.2 percent by 2050 (Stockholm Environment Institute 2008).

The most recent report of the Intergovernmental Panel on Climate Change focuses on mitigation and adaptation strategies to reduce the impacts of climate change (IPCC 2014). While recent efforts in the USVI to increase the use of solar energy are a positive step in mitigation, as a small island state, adaptation to climate change variability is the only realistic path for the Territory. Clearly, the USVI Territory will need to incorporate climate change adaptation in its long range public policy, land use planning, and infrastructure capital projects. With respect to hazard mitigation planning, the Mitigation Strategy acknowledges the need to incorporate climate change variability at both a programmatic level and in developing island-specific mitigation actions going forward.

### 5.2.3 SUMMARY OF THE CAPABILITY ASSESSMENT

Having experienced several devastating natural hazard events, the Government of the US Virgin Islands is cognizant of the magnitude of damage that can be inflicted on property and also the loss of life from natural hazards. It is, therefore, the desire of the Government and its agencies to prepare for, and mitigate, the potential damage that could be caused by these hazard events.

However, the Capability Assessment demonstrates that even though committed to hazard mitigation, the full implementation of the hazard mitigation strategy as presented in the 2011 Plan is not possible. Very few of the programmatic and island specific mitigation actions have been implemented over the past three years and a more realistic strategy will be required for the 2014 Plan Update.

Under the present and anticipated near term financial conditions for the US Virgin Islands Government, adequate operating budgets to implement hazard mitigation actions will be severely constrained. In the case of retrofitting critical facilities or undertaking structural mitigation projects, the financial reality over the next three years, implies a heavy reliance on Federal funding sources. VITEMA, DPNR and DPW are the key governmental agencies that have the primary responsibility for the implementation of Hazard Mitigation in the Territory. Each agency presently has numerous unfilled positions making full compliance with program mandates untenable. The lack of essential personnel and insufficient experience exacerbates compliance and enforcement of existing programs and regulatory requirements. Given the budgetary constraints of the Territorial government and the uncertainty of future general revenues, each of these agencies has a need for additional staffing to be able to address the range of goals, objectives and actions included in this Plan Update. In summary, both human resource capacity issues and limited funding for both programmatic and hazard mitigation projects over the next few years will severely constrain broad implementation of the Territorial hazard mitigation strategy.

Several important changes in FEMA's hazard mitigation guidance since the last Plan Update should be emphasized here, particularly given the uncertainty of future general revenues over the next 3 years:

- Implementing flood mitigation measures for severe repetitive loss properties would be funded by FEMA at 100 percent; and, funding for implementation of flood mitigation measures for repetitive loss properties would be funded at 90 percent. Prioritizing efforts to reduce repetitive losses should be emphasized wherever possible in the mitigation strategy.

- The Territory intends to request consideration from FEMA for the Advance Assistance option for expedited HMGP scoping and project development funding following a Presidential Declared Disaster. Staffing and capability issues anticipated in steady-state and immediately following disaster events argue that utilizing a percentage of HMGP funding to quickly analyze the situation post-disaster, to obtain data to prioritize, select, and develop complete HMGP applications.

- VITEMA intends to take full advantage of the Five Percent Initiative, whereby FEMA is willing to reserve up to 5 percent of the total HMGP funds that can be used by the Grantee to pay for a range of activities that are difficult to evaluate against traditional cost effectiveness criteria. This option is very important to the Territory because of the problems associated with the lack of a historical database of disaster-related damages, necessary to effectively conduct benefit/cost analysis for hard mitigation actions.

- VITEMA will pursue all opportunities with FEMA where the cost share can be minimized or eliminated, including planning and hard mitigation projects, and where the cost share could possibly be waived or justification provided as an extraordinary circumstances.

## 5.3 ANALYSIS OF MITIGATION STRATEGY IN 2011 PLAN

### 5.3.1 REVIEW OF GOALS AND OBJECTIVES

The process of reviewing Mitigation Goals and Objectives involved all members of the Hazard Mitigation Steering Committee and three Island Hazard Mitigation Committees. The review of the Goals and Objectives was made with a realistic understanding of the limited existing, and anticipated technical and financial capacity of VITEMA to implement the hazard mitigation strategy over the next Plan implementation cycle.

The Committees came to consensus that the Goals and Objectives of the 2011 Plan continued to be a viable overall framework for the Territory's mitigation strategy. The Committees revised Objective 1 of Goal 1 to **prioritize hazard mitigation actions that would lead to a reduction of repetitive loss properties throughout the Territory.** The emphasis on reducing repetitive properties is also reflected in a number of programmatic and island-specific actions in the 2014 Plan Update. In addition it has been revised and integrated into this Plan Update as a revised Appendix C Repetitive Loss Strategy.

### 5.3.2 REVIEW OF MITIGATION ACTIONS

The programmatic mitigation actions from the 2011 Plan Update were reviewed and then discussed at the May 13, 14, and 15, 2014 meetings held on St. Thomas, St. John and St. Croix with the respective Hazard Mitigation, Monitoring and Evaluation Committees. The consensus of the participants was to add 8 programmatic actions and to add 17 island specific actions for the Territory which are reflected in Section 5.5.3.1, 5.5.3.2, and 5.5.3.3.

As noted in Sections 5.3.1 and 5.2.2 above, the mitigation strategy reflects a realistic assessment by VITEMA and the islands Hazard Mitigation Committees limited technical and financial capacity as well as the findings of the risk assessment.

A more extensive process was followed for the development of island specific mitigation actions for this Plan. Recommendations for hazard mitigation actions was one of the important outcomes of public information workshops held on St. Thomas, St. John, St. Croix, on May 13, 14, and 15, 2014, respectively. These workshops provided valuable insight into the desires and concerns of the public relating to existing hazard mitigation actions which were identified previously by the island hazard mitigation committees.

VITEMA presented a prioritized listing of mitigation actions to the island Hazard Mitigation Committees via email correspondence on May 16, 2014 so that representatives of the three committees could concur on the

priority of hazard mitigation action items. Committee members were asked to prioritize each mitigation action on the basis of the action's potential for loss reduction and to consider all the evaluation criteria included in the STAPLEE criteria. These considerations include:

- S for socially acceptable
- T for technically feasible
- A for administrative (having the capability and capacity to undertake the action)
- P for politically acceptable
- L for legal (having the legal authority to implement the action)
- E for economic (stressing adequate funding to implement the action)
- E for environment (understanding positive and adverse impacts of the action)

The resultant communication from the island hazard mitigation committees provided the basis for the consultant team, along with VITEMA, to review and evaluate actions and facilitated a final ranking process using a simple ranking protocol of high, moderate or low priority to rank each remaining or newly proposed mitigation action.

It is important to note that there has been some, albeit limited, progress in the implementation of past plan actions. Having public sector representation in all three Island Hazard Mitigation Committees was vital in determining which of the mitigation actions from the 2011 Plan had been fully or partially implemented. The major successes to report include:

- STT-2 -Pursue road reconstruction and drainage improvements to resolve recurrent flooding on Commandant Gade Gut (Garden Street) from Bunker Hill to Veterans Drive that affect businesses and emergency access.
- STT-3 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Radets Gade from Main Street to Veterans Drive that affect businesses.
- STT-4 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Storre Tvaer Gade from Main Street to Veterans Drive that affect businesses.
- STT-23 - Installation of High Impact Hurricane windows at the Department of Public Works (HMGP-1807).
- STT-22 - Installation of High Impact Hurricane windows at the Department of Property and Procurement (HMGP-1807).
- STT-24 - Installation of High Impact Hurricane windows at the Department of Education (HMGP-1807).
- STT-25 - Installation of High Impact Hurricane windows at the Department of Human Services (HMGP-1807).

- STT-11 - Pursue the acquisition of land for the relocation of the Downtown Fire Station that is susceptible to storm surges and tsunami.
- STX-17 - Install storm shutters at the American Red Cross (HMGP-1807).
- STX-18 - Install storm shutters Emile Henderson, Sr. Fire Station (HMGP-1807).
- STX-19 - Install Roll-Up Doors at the Rencelier I. Gibbs Fire Station (HMGP-1807). Note: roll-up windows were installed instead.
- STX 21 - Install Fabric Shutter system at Henry E. Rohlsen Airport (HMGP-1807).
- STJ-10 - Install Storm shutters at the DeCastro Health Clinic (HMGP 1807).
- STJ -12 - Clean Gut at Westin Hotel.

For further discussion as to specific actions that were completed, deleted or deferred, please refer to Section 6.6 of the Plan Update and to Appendix D. Appendix D presents a matrix that provides an overview of all mitigation actions included in the 2011 Plan that were either completed, removed or remain valid.

# 5.4 GOALS AND OBJECTIVES

The Mitigation Strategy includes a series of proposed mitigation actions based on goals and objectives established as part of an overarching hazard mitigation framework for the US Virgin Islands. As used in this Plan, these key terms are defined as follows:

- **Goals:** Broad policy statements, to be achieved through the implementation of specific objectives. They served as the framework for obtaining the desired results over the long-term planning horizon.

- **Objectives:** Specific steps to support, correspond and define a path on how to attain the desired goals and lead to their implementation.

- **Actions:** Efforts that seek to reduce or eliminate risk (see Appendix F). Actions can be grouped into two broad categories:

  ✓ Programmatic or "soft" mitigation actions implemented through legislation, regulations or programs that operate on a Territory-wide level. One good example of programmatic actions is strengthening engineering specifications that address hazard risk reduction in the design and construction of public and private roads.

  ✓ Projects that are designed and constructed to eliminate or reduce future disaster damages. Projects can include personal property and natural resource protection.

## 5.4.1 IDENTIFICATION OF GOALS AND OBJECTIVES

The Strategy for the Plan Update has not fundamentally changed since the 2005 and 2008 plans. In 2004 and 2005, VITEMA identified four (4) goals and several related objectives based on the risk assessment and capability assessment. Both the findings of the risk assessment and capability assessment have not changed significantly in the past three years. Therefore, it was not considered necessary to develop new goals and objectives.

It is important to note that the process of developing the goals and objectives in the previous Plan also involved a review of multi-hazard and hazard specific mitigation plans previously prepared for the US Virgin Islands, including:

- Phase 4 Report, Earthquake Hazards Reduction Plan, Geoscience Associates, for VITEMA, funded by FEMA grant EMA-K-86-0055 (1987);

- Natural Hazard Mitigation Plan for the US Virgin Islands, David Brower, Esq. and Timothy Beatley, Ph.D., for VITEMA (1988),

- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for VITEMA (1995);

- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for OMB (1999); and

- Virgin Islands Flood Hazard Mitigation Plan, Island Resources Foundation for VITEMA, funded by FEMA FMA grant (2000).

These plans provided, and continue to provide, a sound set of guiding principles for developing and implementing hazard mitigation actions in the US Virgin Islands.

### GOAL 1: REDUCE THE NEGATIVE IMPACTS OF NATURAL HAZARDS ON RESIDENTS AND PROPERTY

Background

A fundamental guiding principle of the Territory that is indicated consistently in the past planning efforts is to eliminate or reduce human loss and suffering, and property losses resulting from natural disasters. This protection extends to both residents of, and visitors to, the Islands. As demonstrated in Section Four, much of the existing development in the US Virgin Islands is already at substantial risk to natural disasters:

- Developments are located in high-hazard prone areas;
- Structures have been constructed in natural drainage guts; and
- Many buildings have been constructed in hillside areas without adequate attention to the potential for severe earthquake damages.

However, development pressures in recent years have substantially damaged many important elements of the natural environment. This activity further threatens continued destruction in the future, particularly during hazard events. Preserving ecological integrity involves limiting the degradation of the environment and natural systems such as wetlands, floodplains, coral reefs, sea grass beds, and mangrove swamps. Protection of the natural environment of the US Virgin Islands is important and consistent with hazard mitigation.

So is the protection of properties, particularly those that are repetitive and severe repetitive loss properties. This goal is clearly consistent with FEMA's HMA grant program requirements. Specific actions in highlighted under Objective 1.1, focus on "hard" or "structural" actions that focus on minimizing repetitive losses, while the programmatic actions highlighted under Objective 1.2 and 1.3 focus on educational outreach in which the repetitive loss program is included.

Under this Goal and the pursuant objectives, the USVI has identified specific actions in the Plan Update for mitigating repetitive losses. These specific actions, as outlined in territory-wide and island-specific actions, contribute to the Territory's seeking an increased percentage of Federal grant funds.

Objectives

1.1 Protect existing development from future hazard events with the priority given to projects that would reduce the number of repetitive loss properties

1.2 Increase the awareness and understanding of residents and the private sector to the principles of hazard mitigation

1.3 Preserve, enhance, and restore features of the natural environment that have hazard mitigation benefits

### GOAL 2: INTEGRATE HAZARD MITIGATION AND SUSTAINABLE DEVELOPMENT PRINCIPLES INTO ONGOING GOVERNMENT OPERATIONS AND LONG TERM PLANNING INITIATIVES TO REDUCE THE VULNERABILITY OF FUTURE DEVELOPMENT

Background

There is a direct correlation between hazardous development patterns and the post-disaster emergency and recovery expenses that must be assumed by the public sector. If buildings and infrastructure were not located in a hazardous area, there would be little or no need to expend public funds to rebuild and restore them. The expense of sheltering, rescue and other emergency response functions would be greatly reduced if people and development were kept out of harm's way in the first place. Future growth and development in the Islands is inevitable and may provide short term benefits for a localized economy, but it need not occur in ways that place people and property at risk and burden all the resources of the Territory. US Virgin Islands, like many of the small, island nations in the Lesser Antilles, must create a more sustainable future that addresses environmental, social and economic health.

Another of the guiding principles of the Territory is that the most cost effective way to implement hazard mitigation throughout the US Virgin Islands is to better integrate hazard mitigation in the subdivision and development review and the land use planning processes. The intent is that all new development be carefully managed and planned so that natural hazards are avoided – or where they cannot be avoided - their impacts are minimized. While it can be quite costly to correct past mistakes with respect to development in hazardous locations, there exists a broad range of opportunities to prevent future development from occurring in ways that make it vulnerable to natural hazards.

Environmentally sensitive areas are frequently subject to the effects of natural hazards. Thus, by limiting development in these locations, environmental protection and risk reduction objectives are achieved simultaneously. It is also important to note that tourism is a key element of the local economy. A healthy tourism economy cannot thrive and grow unless prospective tourists perceive the Islands as a safe place in which to visit and vacation. However, continued viability of the tourist economy also depends on the ability of the Territory to preserve the beauty and natural features that attract people in the first place. Obvious elements of this attraction include the beaches, green vegetated hills, the blue waters, and coral reefs.

No mitigation actions are being proposed for Goal 2 in the 2014 Plan Update owing to VITEMA's capacity issues, including both human and financial resources, to undertake actions that will require extensive inter-agency coordination over the next three years. However, the objectives listed below and the goal of integrating hazard mitigation into land and coastal zone planning to build a more sustainable future is valid and should be revisited during the next Update to determine whether Territorial resources are adequate to re-engage in this important initiative.

Objectives

2.1 Ensure that hazard mitigation principles are incorporated into the development review process

2.2 Include hazard mitigation as a key element in long range planning efforts that address comprehensive land use, natural resource management, and socio-economic issues

2.3 Ensure that hazard mitigation design criteria are incorporated into the planning and engineering design for future infrastructure improvements and major public sector investment projects

## GOAL 3: RAPIDLY RESTORE ESSENTIAL INFRASTRUCTURE, WITH UNINTERRUPTED OPERATION OF CRITICAL FACILITIES AND CONTINUITY OF GOVERNMENT SERVICES FOLLOWING A NATURAL HAZARD EVENT

Background

Just as private development is subject to damage and destruction from natural hazards, so are public investments such as: schools, government buildings (whether owned or leased), public roads and streets, airports, port facilities, and other public infrastructure such as electrical power generation and distribution, and water and wastewater treatment plants.

These investments can be located, designed and constructed in ways that minimize their vulnerability. Public roads can be located outside of the floodplains, be designed to minimize impacts to the floodplain, or be elevated above predicted flood levels. Drainage systems can be designed to safely pass floodwaters downstream. Efforts can also be made to correct for past mistakes, for example, retrofitting critical public facilities so that they will better withstand high wind or earthquake events.

Objectives

3.1 Enhance capabilities of public agencies to ensure the continuity of government services following a natural hazard event

3.2 Reduce the vulnerability of essential infrastructure and critical facilities

## GOAL 4: ENHANCE THE CAPABILITIES OF VITEMA AND THE GAR'S OFFICE TO EFFECTIVELY ADMINISTER FEMA MITIGATION PROGRAMS

Background

A broad range of enhancements are possible in terms of increasing the Territorial capabilities to address hazard mitigation. These recommendations have been cited in Section Three. The following objectives are based on these recommendations. However, recognizing that limited resources must be prioritized, these objectives focus on the areas where increased capabilities will have the most immediate effect during the three year horizon for this Plan.

Many of the programmatic actions in this Plan Update focus on developing capabilities of VITEMA. The identified actions focus on developing capabilities to gather data and implement management systems, particular as they relate to increasing a repository of hazard data and repetitive loss properties.

VITEMA already has access, through FEMA, to some information concerning repetitive loss properties. It also has access to information concerning property ownership and valuation. It is necessary to note that some data, which may be considered confidential or sensitive may prove critical for the effective implementation of actions that pertain to the implementation of actions that require substantial economic resources such as those identified for acquisition.

Specific actions that pertain to this goal and objectives focus on gathering information and building program capabilities that are consistent with the goals of FEMA's HMA grant programs and repetitive and severe repetitive loss claim data. The pursuant actions identified in this Plan Update contribute to meeting the USVI priority for reducing repetitive losses, development of action to implement the repetitive loss strategy, and reducing the cost share under HMA program criteria.

Objectives

4.1 Strengthen project implementation capabilities

4.2 Refine program administrative procedures

4.3 Demonstrate improvement in management of FEMA grants through application of established performance standards

# 5.5 IDENTIFICATION, EVALUATION AND PRIOROITIZATION OF MITIGATION ACTIONS

## 5.5.1 IDENTIFICATION OF MITIGATION ACTIONS

The mitigation actions focus on actions that VITEMA may take to reduce the impacts of natural hazards in the Territory. The challenge to implement the Plan Update is the lack of technical and financial resources within VITEMA to manage and coordinate the implementation of specific actions/projects – both "soft" projects (education, training, etc.) and 'hard" constructions projects (flood drainage, structural retrofit, etc.) – with a variety of government agencies. A particular priority of VITEMA is to address the significant impact of repetitive loss properties in the US Virgin Islands families, economy and property. A repetitive loss property is a property that is covered by the NFIP insurance policy and are defined as single or multifamily residential properties that have incurred flood –related damage for which four (4) or more claims payments of at least $5,000.00 have been made, and which the cumulative amount of such claims payments exceed $20,000.00. The Territory's repetitive loss strategy is discussed in more detail in Section 6 of this Plan Update.

An evaluation of the cost effectiveness of many of the mitigation actions identified in the Plan Update is difficult to demonstrate and may not be practical for such a "strategic plan". The quantification of costs associated with "soft" actions and/or projects normally require the calculation of the utilization of internal resources, either human and/or budgetary; while the quantification of benefits is more elusive. The identified "hard" actions or projects, on the other hand, specify locations for structural projects (i.e. flood drainage improvements in St. John) and may be quantified; however, the quantification of costs and benefits require an in-depth engineering assessment to be performed. A formal Benefit-Cost Analysis, including the calculation of a benefit/cost ratio, would be performed at a future date for any projects sent forward for funding consideration under Federal programs.

Nevertheless, the potential for risk reduction or the relative cost effectiveness, environmental soundness and technical feasibility and designation of action priorities for implementation were considered for this Plan Update and are highlighted in the Mitigation Action Plan (Appendix G).

The USVI Territorial Hazard Mitigation Plan includes four separate but related Action Plans presented in Appendix G. Below the Programmatic and Island specific mitigation actions are presented:

Programmatic mitigation actions applicable for the entire USVI Territory (numbered as USVI-#);

(1) Prioritized mitigation actions for St. Croix (numbered as STX-#);

(2) Prioritized mitigation actions for St. Thomas (numbered as STT-#);

(3) Prioritized mitigation actions for St. John (numbered as STJ-#).

## 5.5.2 EVALUATION AND PRIORITIZATION OF MITIGATION ACTIONS

Following the identification of each proposed programmatic and island-specific mitigation actions, VITEMA Steering Committee prepared a preliminary list of mitigation actions for consideration to each of the three Island Hazard Mitigation Committees. The programmatic and island specific committees were reviewed, evaluated and prioritized via email communication that was sent out on May 16, 2014. Each proposed

mitigation action was reviewed and, where necessary, amended, deleted from consideration, and in several instances alternative mitigation actions were developed by Committee members.

Each island mitigation action was then further evaluated. Each action was reviewed based on the examination of the available resources versus the potential benefits of each action on reducing risks to the residents and property in the Territory. A simple ranking criterion was utilized for evaluating the potential for loss reduction.

**Potential for Loss Reduction**

- "H" which represents the highest relative potential for loss reduction;
- "M" which represents moderate relative potential for loss reduction; and
- "L" representing the lowest relative potential for loss reduction.

The programmatic and island specific actions were then prioritized using a simple voting technique. Each member of respective Committees voted on the priority of actions that should be included in the plan. The Voting procedure was based on consensus, which differed from the voting technique utilized in the 2008 Plan Update. The tables below reflect the evaluation of loss reduction potential as well as the prioritization of island specific hazard mitigation actions:

### 5.5.3 IDENTIFICATION, EVALUATION AND PRIORITIZATION OF PROGRAMMATIC MITIGATION ACTIONS

Following the evaluation and prioritization of island specific mitigation actions, the VITEMA Hazard Mitigation Steering Committee reviewed, evaluated and prioritized the programmatic mitigation actions for the entire Territory. The finalized list of programmatic actions was then discussed with the each Hazard Mitigation Committee via a teleconference meeting that was held on May 12, 13, and 14. Table 5.2 below highlights the results of the Hazard Mitigation Committee evaluation and prioritization.

The importance of the implications of climate change variability on hazard mitigation planning for the USVI was noted previously in the Mitigation Strategy. Several of the programmatic actions identified below acknowledge this need and the lack of empirical data to more effectively address those implications. Most important is USVI-9 which proposes to incorporate climate change in the Risk Assessment. Another programmatic mitigation action (USVI-7) proposes to develop a database to track past and future instances of drought, wildfires and landslides, which also has implications for integrating the impact of climate variability by associating occurrences with rainfall events in the case of landslide or lack of precipitation in the case of drought and wildfire. These three hazards were added in the 2011 Plan Update; however, the lack of empirical data limited the analysis of these hazards. All of these hazards will be affected by climate change variability in the future and a more complete database is necessary.

Some of the assumptions of climate change implications that merit further investigation include:

- Future increases in the intensity of rainfall events;
- Extended periods of drought on the islands and potential impacts on wildfires and availability of potable water supplies;
- Sea level rise and increase in storm surge levels, particularly important for St. Croix;

- Potential changes to Special Flood Hazard Areas (SFHA), if climate variability data is integrated into models used in the development of FEMA flood maps.

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| USVI-1 | VITEMA collaborates with DPW to prioritize annual budget and action plans to remove built up sediment, debris and maintain natural guts, roadside ditches, drainage channels and storm drains in areas that are designated in this Plan as **Repetitive Loss Strategy (RLS**) designated areas. | Goal 1, Objective 1.1 | H | E | 1 |
| USVI-2 | Seek FMA funding for a planning study to map of **severe repetitive loss and repetitive loss properties**, conduct limited fieldwork, and evaluate hazard mitigation measures that would cost-effectively address clustered repetitive loss properties. | Goal 1, Objective 1.1 | H | N | 2 |
| USVI-3 | Strengthen partnerships with the Office of the Governor and media to disseminate information to the general public on hazard mitigation programs and importance of reducing number of **USVI repetitive loss properties.** | Goal 1, Objective 1.2 | M | E | 9 |
| USVI-4 | Conduct **watershed planning study** based on a hydrological and hydraulic (H&H) model that would provide the quantitative basis for assessing flood mitigation measures on basin and sub-basin level. The H&H modeling can be used to determine best management solutions for **RLS designated areas** and to build resilience in communities and reduce economic losses. This phased project would begin with St. Croix and take advantage of data developed from previous H&H studies. | Goal 1, Objective 1.1 | H | N | 3 |
| USVI-5 | VITEMA will establish relationships in the steady-state (pre-disaster) timeframe with **US HUD and US DOC** and other representatives of primary Federal agency partners of **NDRF Recovery Support Functions** that could facilitate recovery with technical assistance and potential funding in future post-disaster conditions. | Goal 4, Objective 4.2 | L | N | 4 |
| USVI-6 | Construct a database management program and develop procedures to collect information on and to track **repetitive loss** properties in the Territory. | Goal 4, Objective 4.1 | M | E | 5 |
| USVI-7 | Define and implement arrangements for the collection of data on **Landslides, Wildfire,** | Goal 4, Objective 4.1 | M | E | 6 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | **and Drought** that can affect the Territory, including information on location (maps), history, and probability of hazard events. | | | | |
| USVI-8 | Construct a **database management program** and develop procedures to track mitigation project progress and effectiveness from project award to project completion so as to provide a record on the aggregate actual costs avoided of implemented mitigation projects in the territory. | Goal 4, Objective 4.2 | M | E | 10 |
| USVI-9 | Update the multi-hazard risk assessment to incorporate **climate change models** into the hazard and vulnerability analysis. | Goal 3, Objective 3.1 | L | N | 8 |
| USVI-10 | Develop or update Territorial **Debris Management Plan,** including identification of potential satellite locations for collecting and segregating building and woody debris, white goods, and hazardous materials. | Goal 4, Objective 4.1 | L | N | 7 |

## 5.5.4 Identification, Evaluation and Prioritization of Island Mitigation Actions

It is necessary to note that the effective implementation of mitigation actions is dependent upon: identifying appropriate agency or department roles, projected timeframes, necessary resources, and determining the prioritization for each action. Lead and supporting agency roles, projected timeframes, and potential funding sources were prepared for each action, along with an assessment of anticipated constraints and opportunities for their implementation.

A brief review of the Island Mitigation Actions for St. Thomas, St. Croix, and St. John reflects that many of mitigation actions proposed in the 2011 Plan Update (noted as E in the three tables below), have not been completed over the past three years. There are a number of reasons for this outcome; however, the major ones include:

- The economy of the USVI Territory has struggled over the past six years;
- The closure of the HOVENSA oil refinery on St. Croix in 2012 has had a severe impact on the Territorial unemployment and tax revenues over the past few years;
- The gap between Territorial revenues and annual budget expenditures has continued since 2011, despite efforts of the Government to constrain budgets for Territorial agencies, including VITEMA;

### 5.5.4.1 St. Thomas Mitigation Actions

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| STT-1 | Construct drainage improvements on Turpentine Run (Brookman Road) to alleviate localized flooding. | Goal 1, Objective 1.1 | H | E | 5 |
| STT-2 | Construct drainage improvements to improve the capacity of the drainage system by Yvonne Bowsky Elementary School (Peace Corp) to alleviate localized flooding. | Goal 1, Objective 1.1 | M | E | 14 |
| STT-3 | Construct drainage improvements to improve the capacity, and clean, the storm water drainage system in Frydenhoj (next to and across from ball field) to alleviate localized flooding and damage of private property. | Goal 1, Objective 1.1 | H | E | 26 |
| STT-4 | Construct drainage improvements on Rt. 30 adjacent to Bolongo Bay to alleviate flooding to residential areas and beach erosion. | Goal 1, Objective 1.1 | H | E | 27 |
| STT-5 | Construct drainage improvements for major drainage channel that conveys flood waters from the surrounding Altona and Anna's Fancy areas to resolve recurrent flooding after heavy rainfall events. | Goal 1, Objective 1.1 | H | E | 1 |
| STT-6 | Construct Lindberg Estates, Phase IV Drainage Project north through Kirwin | Goal 1, Objective 1.1 | H | E | 16 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | Terrace Public Housing Units. | | | | |
| STT-7 | Improve drainage infrastructure along Rt. 30 Estate Hope / Fortuna to eliminate flooding of nearby residences in Fortuna 3C Subdivision. | Goal 1, Objective 1.1 | H | E | 19 |
| STT-8 | Expand and reinforce communication infrastructure that is being implemented by BIT to mitigate damages from hurricanes to ensure rapid recovery and return to normal service. | Goal 3, Objective 3.1 | H | E | 13 |
| STT-9 | Replace and improve drainage infrastructure at Food Center in order to resolve flooding of roads, businesses, while addressing potential secondary impacts to wetlands. | Goal 3, Objective 3.2 | H | E | 15 |
| STT-10 | Conduct hydrologic study of the Smith Bay basin and implement drainage improvements to resolve the flooding problems at Coki Point and Smith Bay Roads, and, improvements to open channels draining through the resort complex into Water Bay to resolve localized flooding problems that periodically close roads, create traffic hazards, prevent emergency vehicle and public access, and cause damage to adjacent businesses and road pavement. | Goal 3, Objective 3.2 | H | E | 3 |
| STT-11 | Construct drainage improvements to secondary road that provides access to Caret Bay West. Improvements could include paving and/or providing proper roadside drainage and properly-sized culverts where appropriate to carry stormwater across the road to minimize erosion of the road surface. | Goal 3, Objective 3.2 | M | E | 18 |
| STT-12 | Complete installation of Hurricane Shutters at main police station in Charlotte Amalie. | Goal 3, Objective 3.2 | M | E | 20 |
| STT-13 | Improve drainage infrastructure along Hospital Gade from Antonio Jarvis School to the Police Station on Verteran's Drive, paying particular attention to the intersection of Hospital and Kongens Gade (Moravian Church and Zoras). | Goal 3, Objective 3.2 | M | E | 21 |
| STT-14 | Replace and improve drainage infrastructure along Rt. 33 (Estate Dorethea). | Goal 3, Objective 3.2 | H | E | 22 |
| STT-15 | Resolve flooding problems at Subbase Entrance. Pursue Phase II drainage improvements which include the installation of properly-sized culverts from | Goal 3, Objective 3.2 | H | E | 8 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | Bellows across Veterans Drive to connect to Phase I drainage improvements. | | | | |
| STT-16 | Enlarge box culverts, stormdrains, and improvements to open channels from Veterans Drive to the Bay along the east edge of Frenchtown in southwest Charlotte Amalie (Frenchtown Drainage East), in order to resolve flooding, traffic access and business interruption. | Goal 3, Objective 3.2 | H | E | 10 |
| STT-17 | Harden WAPA Substations. Design and construction of hardened switchgear buildings at the East End and Tutu Substations | Goal 3, Objective 3.2 | H | E | 25 |
| STT-18 | Water Island Ferry Dock at "Philips Landing" experiences periodic flooding in the main turn around area. Periodic flooding caused by inadequate drainage at this facility impedes ferry traffic and emergency vehicles | Goal 3, Objective 3.2 | M | N | 8 |
| STT-19 | Honeymoon Beach at Druif Bay, western end of Water Island; flooding caused from inadequate drainage blocks vehicular passage and covers road with as much as 3 feet on the beach road and then takes as much as 3 weeks to drain. Economic impacts by blocking access to two commercial establishments and public health issue from mosquito breeding. | Goal 1, Objective 1.1 | H | N | 10 |
| STT-20 | Pearl and Larsen School structural retrofit of roof. | Goal 1, Objective 1.1 | H | N | 2 |
| SST-21 | Evelyn Williams School hurricane-strength wind mitigation retrofit of structural roof system and roof replacement. | Goal 1, Objective 1.1 | H | N | 6 |
| SST-22 | Resolve flooding problems at Abattoir Estate Nadir (race track) due to inadequate drainage. | Goal 1, Objective 1.1 | M | N | 23 |
| SST-23 | Address inadequate drainage at Tutu Fire Station | Goal 1, Objective 1.1 | M | N | 12 |
| SST-24 | Structural retrofit of following critical facilities used for sheltering (Lockhart School, Bertha Bochulte Middle School, and, Human Services Head Start building). | Goal 3, Objective 3.2 | H | N | 4 |
| STT-25 | Retrofit of electrical system at Blue Water Bible College to enable back-up power for all 3 main buildings from existing generator. | Goal 1, Objective 1.1 | L | N | 11 |
| STT-26 | Four WAPA power line projects to place feeder lines underground to eliminate damage from hurricane strength winds. They include feeder lines: 9A; 8E; 13; and, | Goal 3, Objective 3.2 | H | N | 9 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | 7E) | | | | |
| STT-27 | Rehabilitation of Water Storage Tank at Sara Hill to include seismic and wind retrofit. Complete rehabilitation and upgrade of the 105 MG Water Storage Tank. Work includes structural repairs and new wind girders and seismic joints. | Goal 3, Objective 3.2 | H | N | 7 |

## 5.5.4.2 St. Croix Mitigation Actions

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| STX-1 | Resolve flooding problems and improve storm water drainage infrastructure in the "Grove at La Reine". | Goal 1, Objective 1.1 | H | E | 24 |
| STX-2 | Conduct a hydrological study of the St. Croix watersheds with particular attention given to the La Grange, Prosperity, Bethlehem and Salt River watershed basins. Attention should focus on upgrading inadequate drainage systems focused on reducing the impact of flooding (see USVI-4 Mitigation Action). | Goal 1, Objective 1.1 | H | E | 1 |
| STX-3 | Perform assessment of flooding problems within La Grande Princess Estate. Approximately 50 of 250 NFIP-insured losses in St. Croix (one in five repetitive losses) occur in La Grande Princess. Eighty two properties were identified as being in the 100 year flood plain and the potential for acquisition, structural solutions, and nonstructural control measures to reduce repetitive losses to residences should be assessed (see USVI-2 Mitigation Action). | Goal 1, Objective 1.1 | H | E | 2 |
| STX-4 | Improve drainage system to along Melvin H. Evans Highway in the area west of Williams Delight Stop Light and Carlton. Extend drainage system to connect with drainage improvements in Williams Delight Community. | Goal 1, Objective 1.1 | M | E | 10 |
| STX-5 | Conduct a hydrological study of the Christiansted watershed or catchment area with particular attention given to the sub-watersheds of Spring Gut and Water Gut to determine technically feasible and cost effective structural solutions to address the flooding problem in | Goal 1, Objective 1.1 | H | E | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | Christiansted. | | | | |
| STX-6 | Resolve flooding problems and improve stormwater drainage infrastructure for "Spring Gut" all the way to Gallows Bay. | Goal 1, Objective 1.1 | H | E | 13 |
| STX-7 | Resolve flooding problems and improve stormwater drainage infrastructure for Tide Village by implementing a low water crossing to divert surface run-off into the natural gut. | Goal 1, Objective 1.1 | H | E | 14 |
| STX-8 | Pursue Christiansted Gut USACE Section 205 Project. Preliminary feasibility phase currently underway by the Corps to determine whether technically feasible and cost effective solutions exist to reduce flood damages in residential and business areas adjacent to King Cross Street. | Goal 1, Objective 1.1 | H | E | 17 |
| STX-9 | Construct a retention pond at the property line of White Bay and the National Park Service reserve within the localized depression. | Goal 1, Objective 1.1 | H | E | 18 |
| STX-10 | Perform assessment of adjacent drainage basins that flow into Estate Williams Delight to identify alternate routing of surface runoff. Evaluate creation of stormwater detention pond below Blue Mountain | Goal 1, Objective 1.1 | H | E | 21 |
| STX-11 | Implement and improve storm water drainage infrastructure to relieve flooding at the Alfredo Andrews School and adjacent low-lying areas. | Goal 3, Objective 3.1 | H | N | 5 |
| STX-12 | Construct drainage improvements at the Ricardo Richards Elementary School at Estate Barren Spot near Melvin H. Evans Highway (Route 66). | Goal 3, Objective 3.1 | H | E | 19 |
| STX-13 | Improve Recovery Hill Water Storage Tanks. Install wind girders to reinforce against hurricane-strength winds. | Goal 3, Objective 3.2 | M | E | 9 |
| STX-14 | Implement and provide emergency power generator units for all wastewater pumping stations on St. Croix. | Goal 3, Objective 3.2. | M | E | 11 |
| STX-15 | Pursue equipment anchoring program for the Richmond Electrical Generating Plant. Anchor critical equipment in the Plant to mitigate damages caused by earthquake, hurricane-strength winds, tsunami and storm surge. | Goal 3, Objective 3.2 | H | E | 15 |
| STX-16 | Improve Various Water Storage Tanks throughout the island. Install flexible connectors at multiple water storage tanks to permit pipe flexibility during earthquake events and ensure rapid recovery and | Goal 3, Objective 3.2 | M | E | 16 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | normal service. | | | | |
| STX-17 | Lew Muckle School shutter project | Goal 1, Objective 1.1 | H | N | 23 |
| STX-18 | The 30" Coastal Interceptor transports sewage from the La Grande Princess area to the LBJ Pump Station in Christiansted. Shoreline erosion from coastal storms has left the interceptor submerged in the sea approximately 50' from the shore. The mitigation action would reroute the pipeline inland, replacing approx. 1900' of pipe, construct new lift station and associated improvements. | Goal 3, Objective 3.2 | H | N | 4 |
| STX-19 | FEMA Community Rating System (CRS). Initiate a planning project to have STX become a CRS Community by developing a strategy and action plan for improving the flood management program on the Island. The planning study would include an outreach strategy and series of community meetings on the NFIP Program, first living floor and base flood elevation determinations, LOMARS, and other flood insurance questions and concerns. | Goal 4, Objective 4.1 | M | N | 3 |
| STX-20 | LBJ Pump Station flood and storm surge protection. The pump station is located 215' south of an existing gut and 125' from the shoreline. Mitigation action involves improving conveyance from existing gut, regarding and rising existing roadway to site, fabrication of flood prevention brackets to provide protection from floodwaters and storm surge. | Goal 3, Objective 3.2 | H | N | 7 |
| STX-21 | Structural retrofits of Claude Markoe School and St. Croix Educational Complex critical facilities used for sheltering. | Goal 3, Objective 3.2 | H | N | 8 |
| STX-22 | Structural retrofits of Juan Luis Hospital for enhanced protection from hurricane-strength winds and earthquake hazards. | Goal 3, Objective 3.2 | H | N | 22 |
| STX-23 | Place Queen Street power lines in Christiansted underground to eliminate damage from hurricane-strength winds. | Goal 3, Objective 3.2 | H | N | 6 |
| STX-24 | Storm flows from Tropical Storm Otto collapsed a culvert and road crossing of Gut 5 in Enfield Green that connects the east and west sides of the Estate. Mitigation action involves replacing culvert with a larger diameter and implementing | Goal 3, Objective 3.2 | M | N | 20 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | drainage improvements on Gut 5. | | | | |

### 5.5.4.3 St. John Mitigation Actions

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| STJ-1 | Conduct a hydrological study of Coral Bay watershed to propose technically feasible and cost-effective solutions to flooding problems due to storm drain locations, undersized drainage, and lack of consideration of natural drainage guts. | Goal 1, Objective 1.1 | M | E | 2 |
| STJ-2 | Evaluate and construct drainage improvements to eliminate localized flooding at the lower end of "Carolina Gut" at Little Plantation where natural storm flows in the catchment area have been altered by construction and improper siting of structures. | Goal 1, Objective 1.1 | H | E | 6 |
| ST-3 | Construct drainage improvements to eliminate localized flooding at Pond Mouth at intersection of Rt. 102 and Rt. 105. | Goal 1, Objective 1.1 | H | E | 7 |
| STJ-4 | Implementing a slope stabilization program to reduce damage and blockage of roads during wind storm and flooding events. A program establishment of more stable and cut and fill slopes, removal of material that may be subject to landslide and rock fall events, re-vegetation, of disturbed slopes, etc. | Goal 1, Objective 1.1 | H | E | 8 |
| STJ-5 | Evaluate and construct drainage improvements to eliminate localized flooding along Route 20 southbound in Coral Bay (Estate Carolina). | Goal 1, Objective 1.1 | H | E | 11 |
| STJ-6 | Increase fuel capacity of the Myra Keating Health Clinic Emergency power generator unit. | Goal 3, Objective 3.1 | H | E | 5 |
| STJ-7 | Provide an alternate power generation substation for Coral Bay to ensure that there is adequate power source for all public services and critical facilities on the east end of the Island. | Goal 3, Objective 3.2 | H | E | 4 |
| STJ-8 | Construct underground feeders from the St. John substation to various termination points within Cruz Bay to mitigate damages to hurricane winds and ensure rapid recovery and return to normal service. | Goal 3, Objective 3.2 | H | E | 9 |
| STJ-9 | Improve drainage infrastructure (Box Culverts) at WAPA building and treatment plant, while addressing potential | Goal 3, Objective 3.2 | H | E | 10 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Existing (E) or New (N) | Priority |
|---|---|---|---|---|---|
| | secondary impacts to wetlands. | | | | |
| STJ-10 | Coordinate with the National Park Service for the construction of appropriate drainage system improvements to eliminate localized flooding along Route Rt. 20 in Maho Bay. | Goal 3, Objective 3.2 | H | E | 12 |
| STJ-11 | Resolve flooding concerns from inadequate drainage at Cruz Bay Fire Station. | Goal 3, Objective 3.2 | M | N | 3 |
| STJ-12 | Functional replacement and relocation of the Fire Station in Coral Bay due to multiple coastal hazards and structural issues of this critical facility resulting from subsidence. | Goal 3, Objective 3.2 | H | N | 1 |

## 5.6 IMPLEMENTATION OF ACTIONS

The Hazard Mitigation Steering Committee considered the cost- effectiveness of all island specific and programmatic actions. The Hazard Mitigation Steering Committee further evaluated each of the identified mitigation actions by utilizing the STAPLEE criteria during meetings held on March 30, 2011.

The Hazard Mitigation Steering Committee was introduced to the STAPLEE process for evaluating both programmatic and island specific mitigation actions as recommended by FEMA guidance. The Hazard Mitigation Steering Committee agreed to use this method to further evaluate prioritized mitigation actions. The STAPLEE method provided the Hazard Mitigation Steering Committee with a systematic way of evaluating the opportunities and constraints of implementing particular mitigation actions that were rated for their loss reduction potential and prioritized through a simple voting technique.

The STAPLEE is an acronym for evaluating each action in terms of Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) factors:

- **S** for Social; the mitigation strategy must be socially acceptable.
- **T** for Technical; the proposed action must be technically feasible.
- **A** for Administrative; the community must have the capability to implement the action (for example, the logical lead agency must be capable of carrying out oversight of the project).
- **P** for Political; mitigation actions must be politically acceptable.
- **L** for Legal; the community currently must have the authority to implement the proposed measure.
- **E** for Economic; economic considerations must include the present economic base, projected growth and opportunity costs.
- **E** for Environmental; the impact on the environment must be considered because of statutory considerations and the public's desire for sustainable and environmentally healthy communities.

Appendix G presents the programmatic and island-specific actions in a matrix format that depicts the prioritization and strategic planning conducted necessary to lead to effective implementation. A separate matrix is provided for each programmatic or island-specific action that includes the following information:

- Description of the mitigation action,
- Potential for Loss Reduction Rating,
- Priority ranking,
- The goal and objective that the action is intended to achieve,
- The specific hazard the action is intended to achieve (or all hazard),
- Responsible agency, department or division,
- Projected timeframe - Short term (1-2 years), Medium Term (3-5 years), and Long Term (5-10 years),
- Projected resources,
- Comments on rationale for action, contribution to goal, or other comment, and
- STAPLEE criteria evaluation, by individual criterion and total score.

Section Six consists of the following six subsections:

- 6.1 IFR Requirements for Plan Maintenance Process
- 6.2 Monitoring, Evaluating and Updating the Plan
- 6.3 Monitoring Implementation of Mitigation Actions
- 6.4 Reviewing Progress on Achieving Goals
- 6.5 Reviewing Progress on Activities and Projects in the Territorial Mitigation Strategy
- 6.6 Progress in Implementation of Past Plan Recommendations and Actions

## 6.1 IFR REQUIREMENTS FOR PLAN MAINTENANCE PROCESS

§201.4(c)(5)(i-iii) of the Interim Final Rule (IFR) requires the Territorial Hazard Mitigation Plan to include a section that describes the Plan Maintenance Process that the Territory will use to ensure that the Plan is current. The specific language in the IFR states that "*the Standard State Plan Maintenance Process" must include:*

- *An established method and schedule for monitoring, evaluating and updating the plan;*
- *A system for monitoring implementation of mitigation measures and project closeouts;*
- *A system for reviewing progress on achieving goals, as well as, activities and projects identified in the mitigation strategy."*

## 6.2 MONITORING, EVALUATING AND UPDATING THE PLAN

### 6.2.1 RESPONSIBLE PARTIES

The US Virgin Islands Territorial Emergency Management Agency (VITEMA) established a Hazard Mitigation Steering Committee for the 2014 Plan Update, and for implementation of actions identified in the Plan.

The newly appointed **Territory Hazard Mitigation Officer, Mr. Haldor Farquhar,** established the Hazard Mitigation Steering Committee, with the charge of overseeing the Plan Update process and for the provision of technical assistance to territorial agencies during the planning process. Mr. Farquhar will act as the chairperson the Hazard Mitigation Steering Committee. The members of the Hazard Mitigation Steering Committee have agreed to work on implementation of actions defined in the 2014 Plan Update. Members are highlighted in Table 6.1.

**TABLE 6.1** ***Hazard Mitigation Steering Committee***

| Name | Agency/ Department |
|---|---|
| Haldor Farquhar*** | VITEMA |
| Austin Callwood | VITEMA |
| Joanne White | VITEMA |
| Malinda Vigilant | VITEMA |
| Renata Christian | VITEMA |
| Debra Henneman-Smith | VITEMA |
| Oliver Morton | VITEMA |
| *** Chairperson | |

The Hazard Mitigation Steering Committee will be in charge and responsible for the implementation of the actions defined in Section Five of this Plan Update. It is necessary to note that this Committee consists of members of VITEMA staff, and it was decided that a smaller committee of emergency management staff, would be more effective in reviewing, monitoring, and evaluating progress in plan implementation.

This Committee will, therefore, be responsible for monitoring progress of the implementation of specific actions and ensuring that the overall goals and objectives of the Hazard Mitigation Plan are reached.

### 6.2.2 MONITORING AND EVALUATING THE PLAN

The Hazard Mitigation Steering Committee will meet once a year to monitor and evaluate progress in plan implementation. This process will include periodically validating underlying assumptions and identifying and securing updated information.

Specific issues that will be monitored and the appropriate procedures include:

1. Changes in information available to perform vulnerability and risk assessments. This will include the collection and update of hazard information, hazard profiles as well as inventory, especially critical facility information from the Department of Property and Procurement.
2. Changes in laws, policies, or regulations: The VITEMA Hazard Mitigation Steering Committee will keep abreast of changes in laws and regulations that have been passed. Particular attention will be given to pending laws as well to determine the potential impacts, if any, to hazard mitigation implementation.
3. Changes in territorial agencies or their procedures that will affect how mitigation programs or funds are administered. This will entail, liaising with Hazard Mitigation Committee members on all three islands and reviewing the different programs in key agencies, such as DPNR, DPW and WAPA. Review of these agencies must entail a determination to ascertain if any changes during the preceding 12 months would affect USVI hazard mitigation programs.
4. Changes in funding sources or capabilities: On an annual basis, VITEMA Hazard Mitigation Steering Committee members would formally convene to review federal funding opportunities

and the administration of grant programs. This will include an overview of project closeouts or new mitigation actions that the Territory is considering. This activity will result in the development report would include the tracking the status of Territorial and Federal funding for hazard mitigation projects.

5. The timing for the annual review should be made in anticipation of the FEMA HMA annual funding cycle so that the findings of the review can be considered prior to finalizing grant applications.

Based on this information, the VITEMA Hazard Mitigation Steering Committee will evaluate the plan annually. The Steering Committee will initiate the evaluations, by formally notifying FEMA Caribbean Area Division (CAD), and execute an action plan to gather information outlined above.

The VITEMA Steering Committee will contact the FEMA CAD and send out a series of letters to Territorial agencies to solicit information. A special session of the Hazard Mitigation Committee will be initiated through teleconference, in order to discuss progress, identify pending items and consider appropriate revisions for the next Plan Update.

VITEMA understands that the next Plan Update cycle may well be five years rather than the historical 3 year cycle.[1] This change will make the annual reviews even more important for monitoring and evaluation of plan progress.

In the first four (4) years of the next Plan Update cycle, VITEMA will make contact with agencies in November to solicit the required information, hold a meeting December (before the Christmas holidays and before December 15th) in order to consider any revisions for the next Plan Update. In the fifth (5th) year, solicitation of information should take place in August and the follow-up meeting should be in September, in anticipation of a complete revision of the Plan that will be submitted to FEMA for re-approval in April of the following year. The evaluations will consider the information gathered as part of the monitoring process described above, and including:

1. Changes in hazard and vulnerability assessment information,
2. Changes in laws, policies, or regulations,
3. Changes in Territorial agencies or their procedures,
4. Changes in funding sources or capabilities, including status of FEMA project closeouts or new mitigation actions that the Territory is considering, and
5. Changes in VITEMA staffing, and/or composition of the Hazard Mitigation Monitoring Committee or island Hazard Mitigation Committees.

[1] April of 2014, FEMA promulgated a Final Rule that changed the frequency of Mitigation Plan Updates (44CRR Part 201). The Final Rule extends the Plan Update requirement for States and Territories from 3 to 5 years.

### 6.2.3 UPDATING THE PLAN

The Plan will be updated and re-submitted to FEMA for re-approval every five years, as required by law. VITEMA also has the prerogative to update the Plan at times other than those identified in this section, under the following general conditions.

1. After a major disaster declaration.
2. At the request of the Governor.
3. When significant new risks or vulnerabilities are identified during monitoring and evaluation procedures.

The VITEMA Hazard Mitigation Steering Committee will initiate and lead all Plan updates. The two sub-paragraphs below describe the procedures for interim and three-year updates, respectively.

#### 6.2.3.1 Updates Resulting from Interim Evaluations

The nature of Plan updates will be determined by the evaluation process described above. In general, the VITEMA Steering Committee will notify the specific island Hazard Mitigation Monitoring and Evaluation Committees that the agency is initiating an interim plan update, and describe the circumstances that created the need for the update. VITEMA will consult the island Hazard Mitigation Committees regarding potential changes. If it is determined that the Hazard Mitigation Committees should be involved, the nature of the involvement will be at the discretion of VITEMA.

When interim updates are completed, VITEMA will advise all Hazard Mitigation Committee members via email that the Plan has been updated, and describe the nature of the update.

#### 6.2.3.2 Updates Related to the Required Three-year Plan Review

As required by the Final Rule (44CFR Part 201), every five years the Plan will be updated for re-submission and re-approval by FEMA. In those years, the evaluation process will be more rigorous, and will examine all aspects of the Plan in detail. It is anticipated that several meetings of the Hazard Mitigation Committees will be required and that the Governor will formally re-approve the Plan prior to its submission to FEMA.

Based on the deadline established for the initial plan in the month of April, VITEMA anticipates that the submission date for the required update will be approximately April, 2019. Prior to that time, VITEMA will contact members of the Hazard Mitigation Monitoring and Evaluation Committee members and other appropriate agencies and organizations to determine a schedule for the Plan update.

The update process will entail a detailed and structured re-examination of all aspects of the Plan, followed by recommended updates. The recommendations will be presented to the VITEMA Director and the Hazard Mitigation Steering Committee, along with the Director, will take appropriate actions.

### *Scheduling Updates*

- Monitoring activities by VITEMA should be done on at the final Hazard Mitigation Steering Committee meeting each year;
- The Plan Update, in view of the criteria set forth in Section 6.2.1 will be documented in a formal memorandum report that defines progress made during the yearly cycle;
- Notices and solicitation of information regarding annual evaluations should be sent out November of the first four years of the Plan and in August of the fifth year.
- The timetable for evaluations and updates for the first four years is expected to last one month, while the evaluation for the fifth year is expected to last three months and be documented for the Plan Update.

# 6.3 MONITORING IMPLEMENTATION OF MITIGATION ACTIONS

## 6.3.1 MONITORING MITIGATION PROJECTS

Mitigation projects are generally monitored as follows.

- Each mitigation project or activity (such as planning) has an established period of performance that VITEMA and FEMA monitor throughout the development and execution of the activity to whom quarterly reports are sent.
- VITEMA regularly meets with representatives from FEMA Region II Caribbean Area Division to coordinate project monitoring activities.
- Every calendar quarter, VITEMA send letters to all sub-grantees with open projects (i.e. ones that have been funded but are not completed), requesting a project progress update.
- Each of the sub-grantees responds to the VITEMA request by preparing a standard report that details progress on individual mitigation projects, and indicates the percentage complete.
- VITEMA compiles the sub-grantee progress reports, and produces a consolidated quarterly report that is sent to FEMA Region II Caribbean Area Division for review.

VITEMA as an agency does not provide separate funding for hazard mitigation projects and does not have any direct influence over the implementation process for projects funded by other Territorial agencies.

For mitigation projects that are funded by non-federal sources such as capital budgets of other territorial agencies, should be described. It will be the responsibility of VITEMA to describe the implementation status of mitigation project, unless otherwise specified at the Hazard Mitigation and Monitoring Committee meetings. The primary focus of these reports will be on providing the VITEMA Steering Committee with an understanding of which projects are progressing well toward meeting scheduled completion dates and which projects may be lagging behind their schedule, requiring intervention.

## 6.3.2 MONITORING PROJECT CLOSEOUTS

Federally-funded mitigation project closeouts occur in the following sequence. These procedures were established in accordance with FEMA HMGP guidelines as set out in the HMGP Desk Reference and the Virgin Islands HMGP Administrative Plan.

- Sub-grantee indicates in a quarterly project progress report that a mitigation project is 100 percent complete.
- VITEMA reconciles FEMA SmartLink account for the project (by disaster).
- VITEMA initiates a comprehensive internal financial audit of the project.
- VITEMA resolves any issues discovered in the audit.

- VITEMA sends FEMA Region II Caribbean Area Division (CAD) a closeout letter that delineates the final eligible cost of the project, and delineates any de-obligations that are required, as well as any monies that will be recovered from the sub-grantee.

## 6.4 REVIEWING PROGRESS ON ACHIEVING GOALS

Subsection 201.4 (c)(5(iii) of the IFR states that the Territorial Hazard Mitigation Plan must include a system for reviewing progress on activities and projects that are included in the mitigation strategy.

In order to monitor progress on achieving the goals identified in this Plan, VITEMA will ensure that both the annual and five-year Plan evaluations include a detailed examination and analysis of the goals, and the various actions that are intended to achieve them. In future versions of the Plan, VITEMA will prepare tables to indicate the status of the various actions based on information from monitoring efforts detailed above, and a general indication of progress. A simple matrix was used during the 2014 Plan Update, which includes:

- Activity Number (delineated by island)
- Type: Existing or New Project
- Status: Implemented, Partially Implemented or Complete
- Description of Project:
- Priority: High, Medium and Low

It is necessary to note that for the Update of this Plan, there were no annual meetings or reports prepared for the specific purpose of updating the Plan. Therefore, the goals and underlying assumptions of the Plan were reviewed during the VITEMA Hazard Mitigation Steering Committee and Island Hazard Mitigation Monitoring and Evaluation Committee meetings that took place during the planning process for this Plan Update (2014).

## 6.5 REVIEWING PROGRESS ON ACTIVITIES AND PROJECTS IN THE TERRITORIAL MITIGATION STRATEGY

Subsection 201.4 (c)(5)(iii) of the IFR states that the Territorial Hazard Mitigation Plan must include a system for reviewing progress on activities and projects that are included in the mitigation strategy.

As part of the yearly and five-year evaluations and updates to this Plan, VITEMA will initiate a review of all activities and projects noted in the mitigation strategy. The review will take place in stages.

1. VITEMA will assemble a Steering Committee to undertake a preliminary review and analysis of progress on activities and projects that are listed in the mitigation strategy section.
2. The VITEMA Steering Committee will prepare a draft memorandum report that describes progress, remaining tasks and projected time to complete.

3. The draft memorandum report will be presented to the Director during its final annual meeting related to the yearly (and five-year) updates.
4. After Director's review, comment and approval, results of the progress review will be added as an addendum to Plan.
5. VITEMA will submit the summary memorandum report describing the results of the yearly program evaluations to FEMA Region II CAD.

Again, no formal documentation or annual reports were developed for the review or monitoring of mitigation projects identified in the 2011 Plan. The VITEMA Steering Committee agreed that the review procedures outlined in the 2011, required only slight modification, as outlined in the previous section of this Plan Section (Section 6). The VITEMA Steering Committee concurred that better documentation is required during the upcoming Plan Update cycle.

## 6.6 PROGRESS IN IMPLEMENTATION OF PAST PLAN ACTIONS

Despite severe staffing and funding constraints, it is important to note that there has been some, albeit limited, progress in the implementation of past plan actions since the preparation of the 2011 Plan Update. The Island Hazard Mitigation Monitoring and Evaluation Committees were vital in determining which of the mitigation actions from the 2011 Plan had been fully or partially implemented. The major successes to report include:

- STT-2 -Pursue road reconstruction and drainage improvements to resolve recurrent flooding on Commandant Gade Gut (Garden Street) from Bunker Hill to Veterans Drive that affect businesses and emergency access.
- STT-3 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Radets Gade from Main Street to Veterans Drive that affect businesses.
- STT-4 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Storre Tvaer Gade from Main Street to Veterans Drive that affect businesses.
- STT-23 - Installation of High Impact Hurricane windows at the Department of Public Works (HMGP-1807).
- STT-22 - Installation of High Impact Hurricane windows at the Department of Property and Procurement (HMGP-1807).
- STT-24 - Installation of High Impact Hurricane windows at the Department of Education (HMGP-1807).
- STT-25 - Installation of High Impact Hurricane windows at the Department of Human Services (HMGP-1807).
- STT-11 - Pursue the acquisition of land for the relocation of the Downtown Fire Station that is susceptible to storm surges and tsunami.
- STX-17 - Install storm shutters at the American Red Cross (HMGP-1807).

- STX-18 - Install storm shutters Emile Henderson, Sr. Fire Station (HMGP-1807).
- STX-19 - Install Roll-Up Doors at the Rencelier I. Gibbs Fire Station (HMGP-1807). Note: roll-up windows were installed instead.
- STX 21 - Install Fabric Shutter system at Henry E. Rohlsen Airport (HMGP-1807).
- STJ-10 - Install Storm shutters at the DeCastro Health Clinic (HMGP 1807).
- STJ -12 - Clean Gut at Westin Hotel.

American Planning Association (APA), *Planning for Post-Disaster Recovery and Reconstruction,* by J. Schwab, et. al. for Federal Emergency Management Agency (FEMA), APA Planning Advisory Service (PAS) Report 483/484 (1998)

APA, *Subdivision Design in Flood Hazard Areas,* Prepared by Marya Morris for FEMA, APA PAS Report Number 473 (1997).

ASCE, ASCE Standard No. 7-05, Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-05 (CD ROM),(2006).

Brabb, E. E., 1984, Landslide potential on St. Thomas, Virgin Islands:U.S. Geological Survey Open-File Report 84-762, pp. 97-102.

Brower, D. J. and T. Beatley, *Natural Hazard Mitigation Plan for the U.S. Virgin Islands,* Prepared for Virgin Islands Territorial Emergency Management Agency (VITEMA) (1988).

Stockholm Environment Institute, Bueno, Ramon, and Co-authors. *The Caribbean and Climate Change: The Cost of Inaction.* Stockholm Environment Institute, US Center, and Global Development and Environment Institute, Tufts University (2008).

Bulletin of the American Meteorological Society. Web-based article at www.epa.gov/climatechange/impacts-adaptation/islands.html (May 22, 2014).

CH2MHill, *Planned Drainage Basin Studies for the Protection of Roads from Flood Damage in the USVI: Volume 1 St. Thomas,* Prepared for VI Department of Public Works (1982).

Citigroup, *VI Water and Power Authority Electric System Revenue Bonds,* Prepared for Water and Power Authority (WAPA) (2003).

Dewberry, LLC, *United States Virgin Islands Fiscal Year 2004 Map Modernization Business Plan,* Prepared for FEMA, Region II (2004).

DPNR, NOAA, USDA NRCS, *East End Watersheds Management Plan,* St. Croix East End Marine Park (2011).

Earth Scientific Consultants, *Earthquake Hazard and Vulnerability in the United States Virgin Islands,* Prepared for VITEMA (1999).

EQE International, *Seismic and Hurricane Risk Assessment of Selected Virgin Island Port Authority (VIPA) Facilities,* Prepared for VIPA (2002).

EQE International, *Estimation of Potential Hurricane and Earthquake Losses to Water and Power Authority Facilities, Draft Report,* Prepared for WAPA (1994).

FEMA, *Mitigation Strategy Report: November 2003 Severe Storms, Flooding, Landslides and Mudslides,* FEMA-1503-DR-VI (2004a).

FEMA, *Disaster Management Guide for the US Virgin Islands,* Prepared by FEMA Region II CAO (2004).

FEMA, *USVI Post-Disaster Flood Hazard Verification: Hurricane Lenny, November 1999, FEMA-1309-DR-VI,* Prepared by Dewberry (2002)

FEMA, *Government of the Virgin Islands Mitigation Profile,* FEMA Region II Caribbean Area Office (2001).

FEMA, *Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy (1997).*

FEMA, *Emergency Management Guide for Business & Industry: A Step-by-Step Approach to Emergency Planning, Response and Recovery for Companies of all Sizes,* Sponsored by a Public/Private Partnership (1993).

FEMA, *Hurricane Hugo After Action Report for the USVI,* Prepared by FEMA Region II CAO FCO (undated).

FEMA, *Flood Insurance Study for the United States Virgin Islands,* (2007)

Federal Interagency Floodplain Management Task Force, *Protecting Floodplain Resources: A Guidebook for Communities,* State University of New York, College of Environmental Science and Forestry (2nd Edition, 1996).

FEMA DR-1939-VI, Repetitive Loss/Severe Repetitive Loss Assessment Report, Floodplain Management & Insurance Group (FPM&IN) (2011).

FEMA, *Hazard Mitigation Assistance Unified Program,* DHS FEMA Washington DC (2013).

FEMA, *National Disaster Recovery Framework,* DHS FEMA Washington DC (2011).

FEMA, *Addendum to the Hazard Mitigation Assistance Unified Guidance,* DHS (2013).

Geoscience Associates, *Phase 4 Report: Earthquake Hazards Reduction Plan, U.S. Virgin Islands,* Prepared for VITEMA (1987).

Geoscience Associates, *Phase 3 Report: Vulnerability Analysis, Earthquake Hazards, US Virgin Islands,* Pepared for Disaster Programs Office, Office of the Governor, USVI (1985).

Geoscience Associates, *Phase 2 Report: Vulnerability Analysis, Earthquake Hazards, US Virgin Islands,* Prepared for Disaster Programs Office, Office of the Governor, USVI (1984a).

Geoscience Associates, *Phase 1 Report: Vulnerability Analysis, Earthquake Hazards, US Virgin Islands,* Prepared for the Disaster Programs Office, Office of the Governor, USVI (1984b).

Guidelines and Best Practices to Establish Areas of Tsunami Inundation for Non-modeled or Low-hazard Regions" (see http://nthmp.tsunami.gov/modeling_guidelines.html).

Haiti raises earthquake toll to 230,000". AP. The Washington Post. 10 February 2010. Retrieved 30 April 2010.

Haiti will not die, President Rene Preval insists". BBC News. 12 February 2010. Retrieved 12 February 2010.

International Building Code, International Code Council, (2006).

IPCC AR4, 2007, IPCC Fourth Assessment Report of the Intergovernmental Panel on Climate Change

IPCC AR5, 2014, IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Island Resources Foundation, *Virgin Islands Flood Hazard Mitigation Plan*, Prepared for VITEMA (2000).

Island Resources Foundation, *Mitigating the Impacts of Natural Hazards in the U.S. Virgin Islands,* Prepared for the Executive Office of the Governor, Office of Management and Budget (1999).

Island Resources Foundation, *Mitigating the Impacts of Natural Hazards in the U.S. Virgin Islands,* Prepared for VITEMA (1995).

Legislature of the Virgin Islands, *Virgin Islands Development Law of 2003, Comprehensive Land and Water Use Plan,* Sponsored by Senator Usie R. Richards (June 16, 2004 draft version of Plan).

McCann, W., L. Feldman, and M. McCann, *Catalog of Felt Earthquakes for Puerto Rico and Neighboring Islands from 1492 to 1899 with additional information for some 20th Century Earthquakes,* Island Resources Foundation research data file (date published unknown).

Mueller, Charles, Arthur Frankel, Mark Petersen, and Edgar Leyendecker (2010) New Seismic Hazard Maps for Puerto Rico and the U.S. Virgin Islands. Earthquake Spectra: February 2010, Vol. 26, No. 1, pp. 169-185.

Multer, H.G. and L.C. Gerhard, *Guidebook to the Geology and Ecology of some Marine and Terrestrial Environments, St. Croix, US Virgin Islands,* Special Publication No. 5, West Indies Laboratory, Farleigh Dickinson University, Christiansted, St. Croix (1974).

NOAA, *Final 312 Evaluation Findings of the Virgin Islands Coastal Zone Management Program,*(2003).

NOAA, *The Deadliest, Costliest, and Most Intense United States Hurricanes from 1900 to 2000, and other frequently requested hurricane facts,* Prepared by J.D. Mayfield, E.N. Rappaport and C.W. Landsea and accessed from the NOAA National Hurricane Center Website (2004).

O'loughlin, K. F. And Lander, J. F., Caribbean Tsunamis: A 500-Year History from 1498–1998 (Kluwer Academic Publishers, Dordrecht, The Netherlands (2003).

Parsons, T., and Geist, E.L., 2009, *Tsunami probability in the Caribbean region*: Pure and Applied Geophysics, v. 165, p. 2089-1226, doi:10.1007/s00024-008-0416-7

Post, Buckley, Schuh & Jernigan (PBS&J), *Technical Memorandum: Transportation Analysis for St. Thomas Hurricane Evacuation Study,* Prepared for USACE Jacksonville District (1997).

Preparing Your Community for Tsunamis – A Guidebook for Local Advocates, Version 2.1, February 1, 2008, Laura Dwelley Samant, L. Thomas Tobin, Brian Tucker (http://www.preventionweb.net/files/3984_PreparingYourCommunityforTsunamisV21.pdf).

Red Cross: 3M Haitians Affected by Quake". CBS News. 13 January 2010. Retrieved 13 January 2010.

Salomon, Smith, and Barney, *Virgin Islands Water and Power Authority Water System Revenue and Refunding Bonds,* Prepared for WAPA (1998).

Taylor, M. A., and Coauthors, 2007: Glimpses of the future: A briefing from the PRECIS Caribbean Climate Change Project. Caribbean Community Climate Change Centre, 24 pp.

Trotman Adrian, Mehdi, Bano, Gollamudi, Apurva and Senecal, Catherine, Drought and Precipitation Monitoring for Enhanced Integrated Water Resources Management in the Caribbean (2008).

URS Corporation (formally Woodward-Clyde), *Summary of Activities Supporting the Department of Planning and Natural Resources, US Virgin Islands, (FEMA 1067-DR-VI),* Prepared for FEMA Disaster Field Office (1996a).

URS Corporation (formally Woodward-Clyde), *Evaluation of Residential Mitigation Strategies: Hurricane Marilyn in the US Virgin Islands (FEMA 1067-DR-VI),* Prepared for FEMA Headquarters Mitigation Directorate (1996b).

U.S. Army Corps of Engineers (USACE), *Hurricane Marilyn After Action Report for the USVI and Puerto Rico,* Prepared by USACE Jacksonville District on behalf of FEMA (1996a).

U.S. Army Corps of Engineers, *Hurricane Marilyn Storm Surge Flooding in the USVI,* Prepared by USACE Jacksonville District on behalf of FEMA (1996b).

U.S. Army Corps of Engineers, *Hurricane Evacuation Study for the United States Virgin Islands: Technical Summary,* Prepared for VITEMA (1994a)

U.S. Army Corps of Engineers, *Hurricane Evacuation Study for the USVI: Appendix 2 Hazard Analysis, Behavioral Analysis and Transportation Analysis*, Prepared by USACE Jacksonville District on behalf of FEMA (1994b).

USGRP, *Global Climate Change Impacts in the United States.* United States Global Change Research Program. Cambridge University Press, New York, NY (2009)

US National Assessment of the Potential Consequences of Climate Variability and Change Educational Resources Regional Paper: US-Affiliated Islands of the Pacific and Caribbean, http://www.usgcrp.gov/usgcrp/nacc/education/islands/islands-edu-3.htm

U.S. Office of Insular Affairs (OIA), *1999 Report on the State of the Islands* (1999).

VI Department of Planning and Natural Resources (DPNR), Fiscal Year *2003 Annual Report,* Commissioner Dean C. Plaskett, Esq., St. Thomas, USVI (2004)

VI Department of Planning and Natural Resources, Coastal Zone Management Program, *Virgin Islands Section 6217 Coastal Nonpoint Pollution Control Program,* Prepared by Janice D. Hodge (undated).

VI Department of Public Works, *Status Report: FEMA Hazard Mitigation Flood Control Projects, USVI,* Prepared by Eduardo O'Neal, District Engineer DPW STT/STJ (1997).

VI Program of the Nature Conservancy, *St. Croix East End Marine Park Management Plan,* Prepared for the VI Department of Planning and Natural Resources, Division of Coastal Zone Management (2002).

VITEMA, *USVI Territorial Recovery Operations Plan, Part II: Territorial Disaster Recovery Assistance Handbook on Federal Programs,* VITEMA; St. Thomas (1992).

WAPA, *Virgin Islands Water and Power Authority Emergency Operations Plan,* VI WAPA (2003).

Watlington, R.A. and S. H. Lincoln, *Disaster and Disruption in 1867: Hurricane, Earthquake and Tsunami in the Danish West Indies: A Collection of Accounts and Reports,* Eastern Caribbean Center, University of the Virgin Islands (1997).

# Virgin Islands Territorial Emergency Management Agency (VITEMA)

## Hazard Mitigation Plan Update – Town Hall Meeting

### Sign-In Roster

**Venue:** Gertrude's Restaurant – St. Croix

**Date:** Thursday, May 15, 2014

**Time In:** 5:30 pm **Time Out:** 7:00 pm

| Name / E-mail | Agency | Telephone No. | Fax No. | Signature |
|---|---|---|---|---|
| [redacted] | | | | |

# Virgin Islands Territorial Emergency Management Agency (VITEMA)

## Hazard Mitigation Plan Update – Town Hall Meeting

### Sign-In Roster

**Venue:** Julius Sprauve School - St. John

**Date:** Wednesday, May 14, 2014

**Time In:** 5:50pm **Time Out:** 6:40pm

| Name / E-mail | Agency | Telephone No. | Fax No. | Signature |
| --- | --- | --- | --- | --- |
| [redacted] | | | | |

# Virgin Islands Territorial Emergency Management Agency (VITEMA)

## Hazard Mitigation Plan Update – Town Hall Meeting

### Sign-In Roster

**Venue:** Julius Sprauve School – St. John

**Date:** Wednesday, May 14, 2014

| Name / E-mail | Agency | Telephone No. | Fax No. | Signature |
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# Virgin Islands Territorial Emergency Management Agency (VITEMA)

## Hazard Mitigation Plan Update – Town Hall Meeting

### Sign-In Roster

**Venue:** Emerald Beach Resort – St. Thomas

**Date:** Tuesday, May 13, 2014

**Time In:** 5:40pm **Time Out:** 7:00pm

| Name / E-mail | Agency | Telephone No. | Fax No. | Signature |
|---|---|---|---|---|
| [redacted] | | | | |

# Virgin Islands Territorial Emergency Management Agency (VITEMA)

## Hazard Mitigation Plan Update – Town Hall Meeting

### Sign-In Roster

**Venue:** Emerald Beach Resort – St. Thomas **Date:** Tuesday, May 13, 2014

| Name / E-mail | Agency | Telephone No. | Fax No. | Signature |
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Page 2 of 2

# Virgin Islands Territorial Emergency Management Agency (VITEMA)

## Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: VITEMA (STT) – EOC

Date: Thursday, April 3, 2014

Time In: 5:30p Time Out: 7:00p

| Name / E-mail | Agency | Telephone No. | Fax No. | Signature |
|---|---|---|---|---|
| [redacted] | | | | |

# Virgin Islands Territorial Emergency Management Agency (VITEMA)

## Hazard Mitigation Plan Update – Town Hall Meeting

### Sign-In Roster

**Venue:** VITEMA (STT) - EOC **Date:** Thursday, April 3, 2014

| Name / E-mail | Agency | Telephone No. | Fax No. | Signature |
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ST. THOMAS SOURCE

Tuesday, May 13, 2014 Last Update 1:34pm



Local government — St. Thomas

# VITEMA Holds Public Workshops on Hazard Mitigation Plan

May 13 through 15, the Virgin Islands Territorial Emergency Management Agency (VITEMA) will hold a second round of public workshops to gather public input on updates to the Territory's Hazard Mitigation Plan.

The public is invited to public workshops being held on:

• Tuesday, May 13 — 5:30 p.m., at the Emerald Beach Hotel, Lindbergh Bay, St. Thomas.

• Wednesday, May 14 — 5:30 p.m., at the Julius Sprauve School Auditorium, Cruz Bay, St. John.

• Thursday, May 15 — 5:30 p.m., at Gertrude's Restaurant, Castle Coakley, St. Croix.



SOURCE PICKS

Unemployment Stuck — Water Standards ... for September

# Community Calendar

*St. John Tradewinds* welcomes notices of community-oriented, not-for-profit events for inclusion in this weekly listing. Call 776-6496, e-mail editor@tradewinds.vi or fax 693-8885.

**Wednesday, May 14**

— The Virgin Islands Police Department will celebrate National Police Week with an open house at Leander Jurgen Command on Monday, May 12, from 12 to 3 p.m. in Cruz Bay.

**Wednesday, May 14**

— The Virgin Islands Territorial Emergency Management Agency (VITEMA) will have a second round of public workshops to gather public input on updates to the territory's Hazard Mitigation Plan. The St. John workshop is scheduled for Wednesday, May 14, at 5:30 p.m., at the Julius Sprauve School Cafeteria in Cruz Bay.

— The Virgin Islands Police Department will celebrate National Police Week with a fun day at Julius E. Sprauve School on Wednesday, May 14, from 8 a.m. to 3 p.m.

**Thursday, May 15**

— The Office of the Governor in partnership with the Departments of Education and Public Works announces a public scoping meeting to solicit recommendations for a new St. John School under consideration for the island of St. John. The meeting will be at the Julius E. Sprauve School cafeteria on Thursday, May 15, from 6 to 8 p.m. Preliminary educational program requirements and key milestones in the process to date will be outlined.

**Saturday, May 17**

— The Animal Care Center of St. John has rescheduled Wagapalooza, due to inclement weather, for Saturday, May 17, from 5 to 8 p.m. at the Winston Wells Ball Field in Cruz Bay.

— The University of the Virgin Islands will host its 2014 Commencement Ceremonies at 7 p.m. on Saturday, May 17, in the Sports and Fitness Center on the St. Thomas Campus

**Sunday, May 24**

— The 11th annual Beach-to-Beach Power Swim will be on Saturday, May 24. The event is set in the protected waters of Virgin Islands National Park along the north shore of St. John.

**Monday, June 30**

— Lt Gov. Gregory Francis is strongly encouraging and reminding corporate citizens to meet the June 30 deadline for franchise taxes and annual filing requirements. Failure to comply with the annual filing requirements will result in the assessment of penalties and interest, withdrawal of good standing status, or even administrative dissolution.

# VITEMA Hosting Hazard Mitigation Plan Workshop on May 14

*St. John Tradewinds*

The Virgin Islands Territorial Emergency Management Agency (VITEMA) will have a second round of public workshops to gather public input on updates to the territory's Hazard Mitigation Plan.

The St. John workshop is scheduled for Wednesday, May 14, at 5:30 p.m., at the Julius Sprauve School Cafeteria in Cruz Bay.

The purpose of the USVI Hazard Mitigation Plan is to identify activities that can be undertaken by both the public and the private sectors to reduce property damage caused by hazards including floods, earthquakes, and hurricanes. While these hazards are acts of nature, the impacts on residents, public facilities, businesses, and private property can be diminished through hazard mitigation planning.

VITEMA is directing this territory-wide planning effort which is being funded by a grant from the Federal Emergency Management Agency (FEMA). The planning activities have been coordinated through a Hazard Mitigation Planning Committee created by VITEMA.

"A participatory planning process is vital for the development of a comprehensive mitigation plan as it is only through public participation that the priorities of the community are reflected," said Haldor Farquhar, VITEMA State Hazard Mitigation Officer. "In this regard, the public workshops are an important forum for understanding community concerns and incorporating feedback from government agencies, businesses and citizenry into the plan."

The Hazard Mitigation Plan will document information on the frequency of occurrence of natural hazard events, utilizing past disaster damages to understand the impact or vulnerability to natural hazards. A series of estimates will be used to understand the extent of hazards and potential property damages that may result from specific hazards. The resulting information will outline the full range of hazards the territory faces, from hurricanes to landslide —and potential social impacts, damages and economic losses.

"The territory's Hazard Mitigation Plan is an important tool for VITEMA and the government because it provides a comprehensive review of the natural hazards and their potential impacts to citizens and property," sad Elton Lewis, VITEMA Director. "By understanding the risks, we can outline and prioritize mitigation strategies that will help protect our communities."

Lewis added that community participation and feedback in the planning process is critical to the success of the plan because the local government, the private sector and non-profit stakeholders will ultimately be responsible for implementing the actions outlined in the mitigation plan. More importantly, the Virgin Islands will benefit from the federal grants for mitigation of hazards identified in the plan, he said.

For more information contact Haldor Farquhar, VITEMA State Hazard Mitigation Officer, at 340-774-2244 or via email at haldor.farquhar@vitema.vi.gov.

## US VIRGIN ISLANDS REPETITIVE LOSS PROPERTIES STRATEGY

The US Virgin Islands has formulated a strategy to effectively address the significant negative impact of Repetitive Loss properties on the Territory's families, economy and property. On June 30, 2004, the National Flood Insurance Act (42 U.S.C 4001 et seq) was amended to "introduce a mitigation plan requirement as a condition of receiving a reduced local cost share for the activities that mitigate severe repetitive loss properties under the Flood Mitigation Assistance and Severe Repetitive Loss grant programs. The October 31, 2007, interim final rule established this requirement under the 44 CFR § 201.4 (c)(3)(v) to allow a state to request the reduced costs share under the FMA and SRL programs if it has an approved State Mitigation Plan that also includes an approved Severe Repetitive Loss Strategy" (FEMA, Multi-Hazard Planning Guidance, 2008).

As noted in Section 2.4, the Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims and Severe Repetitive loss grant programs. To encourage efforts by states and local jurisdictions, FEMA has changed the cost-share requirements to allow more Federal funds for properties with repetitive flood claims and severe loss properties. Implementing flood mitigation measures for severe repetitive loss properties would be funded by FEMA at 100 percent; and, funding for implementation of flood mitigation measures for repetitive loss properties would be funded at 90 percent. Given the stark economic reality in the USVI, focusing the mitigation strategy on addressing repetitive losses is the best option for the USVI Territory.

**A Repetitive Loss (RL) property is** a structure covered by a contract for flood insurance made available under the NFIP that:

(a) Has incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and

(b) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

**A Severe Repetitive Loss (SRL) property** is defined as a residential property that is covered under an NFIP flood insurance policy and:

(a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
(b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
(c) For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

Actions undertaken by the USVI Territorial Government include implementing a FMA grant to address three Repetitive Loss properties in Sugar Estate on St. Thomas. The three properties included the St. Andrews Episcopal Church and a 3-story, multi-family housing project. The hazard mitigation project was completed

in 2009. The Territorial Government first formulated the Repetitive Loss Properties Strategy during the last Plan Update in 2011. Since that time, VITEMA has been working to implement the strategy through the full range of its hazard mitigation planning activities.

A major drainage improvement project has been completed in the Havensight area that has benefited surrounding residential and commercial areas including clusters of repetitive losses.

The primary objective of this strategy is to increase awareness of the negative impact of repetitive loss properties and the benefits of mitigation actions and to eliminate or reduce the total number of repetitive loss properties in the Territory.

Therefore, the Territory's approach is primarily focused on public education, data collection, and direct mitigation actions focused on minimizing repetitive losses. These are highlighted in the Plan Update in the following areas:

- Educational Outreach – where specific actions focus on developing an outreach program to provide the community with hazard mitigation educational materials include those on the NFIP, Community Rating System, as well as repetitive loss concerns. These outreach activities will educate citizens on the impact of repetitive loss properties in their communities and suggest ways to reduce flood insurance premiums. More specific programs will provide professionals and private sector guidance on retrofitting options and opportunities for repetitive loss properties (see programmatic Action 2 and 3).

- Data Collection – where specific action is taken by VITEMA to collect important information for the implementation of island specific actions focused on minimizing losses in high priority repetitive loss properties. Programmatic Actions #5 is specifically focused toward this program and will help with the implementation of the specific projects.

- Annual Reporting – the collection of data will also facilitate plan implementation and monitoring highlighted in Section Six. Better data collection by VITEMA will facilitate more accurate reporting on the total number of repetitive loss properties that are either targeted or retrofitted by the Territory.

- Targeted Actions – In meetings of the Hazard Mitigation Steering Committee leading up the 2014 Plan Update, a consensus was reached that mitigation actions proposed in the Plan should be prioritized with the actions reducing the number of repetitive loss properties having the highest priority. There are a number of specific mitigation actions that seek to minimize flood related losses associated with repetitive properties. Many of these projects involve drainage improvements but could also involve acquisitions, elevations, or other flood protection measures.

## C.1 REPETITIVE LOSS PROPERTIES DATA

In preparation for this 2011 Plan Update, VITEMA requested data from FEMA regarding the identified Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties in the Territory. In March 2011, FEMA provided RL and SRL data as of November 2010, in the form of the RL and SRL assessment report completed for DR-1939. The table below shows the data received, which is the latest data available.

**TABLE C.1** ***US Virgin Islands RL/SRL Property Statistics***

| County | RLP Count | Percentage of RLP for USVI | SRLP Count | Insured Properties | Losses | Buildings Payment | Contents Payment | Total Paid | Percentage of Total USVI Payouts |
|---|---|---|---|---|---|---|---|---|---|
| ST. CROIX | 133 | 53.85% | 3 | 72 | 355 | $ 7,902,668.53 | $ 8,033,674.98 | $ 15,936,343.51 | 47.69% |
| ST. JOHN | 2 | 0.81% | 0 | 1 | 4 | $ 219,662.16 | $ 48,361.70 | $ 268,023.86 | 0.80% |
| ST. THOMAS | 112 | 45.34% | 0 | 37 | 311 | $ 3,583,351.96 | $ 13,629,364.55 | $ 17,212,716.51 | 51.51% |
| WATER ISLAND | 0 | 0.00% | 0 | 0 | 0 | $ - | $ - | $ - | 0.00% |
| TOTAL | 247 | 100% | 3 | 110 | 670 | $ 11,705,682.65 | $ 21,711,401.23 | $ 33,417,083.88 | 100% |

As of November 2010 there were two hundred and fifty (250) RL properties identified in the NFIP BureauNet data system, with total claims paid of $33.4 million over the last 30 years. However, of those 250 structures, 21 were identified as duplicate entries. In addition, 3 structures were found to have been mitigated by a flood control project using funds from FMA, and 1 was a vacant lot. Therefore, as a result of the field verification process the total amount of RL structures in the USVI has been decreased from 250 to 225. The following table illustrates the results of this field inspection survey.

**Table C.2** ***RL/SRL Validated Properties, as a Result of Field Inspection Summary***

| CITY, STATE | RLP | SRLP | Insured | Located | Unable to Locate | Pending Inspections | Duplicated | Mitigated | # Reports | TOTAL (internal: minus DUP & MIT) |
|---|---|---|---|---|---|---|---|---|---|---|
| St. Croix, USVI | 133 | 3 | 72 | 104 | 21 | 0 | 11 | 2 | 125 | 123 |
| St. John, USVI | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 2 |
| St. Thomas, USVI | 112 | 0 | 37 | 73 | 27 | 2 | 10 | 2 | 102 | 100 |
| | 247 | 3 | 110 | 179 | 48 | 2 | 21 | 4 | 229 | 225 |

While the data provided by FEMA is illustrative of the number of NFIP-insured properties that meet the definition of Repetitive Loss or Severe Repetitive Loss, the information has limited uses in the development and implementation of the Territory's SRL Strategy. Without specific addresses, it is difficult to develop a targeted strategy to address RL and SRL structures throughout the Territory. In addition, the FEMA-provided data is limited to only those structures which are NFIP-insured, which likely does not account for the majority of repetitive loss structures in the Territory, as many are not insured through the NFIP.

As a supplement to the data received from FEMA data, and in an effort to develop a strategy that will target all properties known to suffer repetitive loss, VITEMA has included information on areas and neighborhoods known to be prone to repetitive flood loss. These areas and neighborhoods were identified by VITEMA and the Department of Permitting and Natural Resources, by staff with knowledge of the nature, frequency and effects of repetitive flooding in the areas. Those areas and neighborhoods are identified below, and are organized by island.

**TABLE C.3** ***VITEMA-Identified Repetitive Loss Areas or Neighborhoods***

| Island | Area or Neighborhood | Type of Development | Description of Known Flooding Issues |
|---|---|---|---|
| St. Thomas | Charlotte Amalie Main Street Area | Primarily commercial area with historic structures and drainage | Flooding primarily results from storm surge and exceptionally high tide events - Some flooding caused by storm water runoff and inadequate drainage |
| | Turpentine Run area | Primarily commercial | Flooding caused by storm water runoff and inadequate drainage |
| | Nadir area | Residential, single-family structures | Flooding caused by storm water runoff and inadequate drainage |
| | Bovoni Area (Thomasville Community) | Residential, single- and multi-family structures | Flooding caused by storm water runoff and inadequate drainage |
| | Bolongo Bay area | Residential, single-family structures | Flooding caused by storm water runoff and inadequate drainage |
| | Smith Bay area | Mixed use (residential and commercial) | Flooding caused by storm water runoff and inadequate drainage |
| | St. Peter area | Residential, single-family structures | Flooding caused by storm water runoff and inadequate drainage |
| St. Croix | Gallows Bay / Spring Valley area | Mixed use (residential and commercial) | Sheet flow flooding caused by storm water runoff and inadequate drainage |
| | La Grand Princess area | Mixed use (residential and hotel) | Flooding caused by storm surge, storm water runoff and inadequate drainage |
| | Sion Hill area | Mixed use (largely residential, come commercial) | Flooding caused by storm water runoff and inadequate drainage |
| | Estate Castle area | Mixed use (residential and commercial) | Flooding caused by storm water runoff and inadequate drainage |
| | Estate Barren Spots area (includes Strawberry Estate, Strawberry Hill, Estate La Reine) | Mixed use (residential and commercial) | Flooding caused by storm water runoff and inadequate drainage |
| | Mon Bijou area | Residential, single-family structures | Flooding caused by storm water runoff and inadequate drainage; significant erosion in the gut |
| | Lorraine Village Apartments area | Residential, single- and multi-family structures | Flooding caused by storm water runoff and inadequate drainage; significant erosion in the gut |
| | William's Delight area | Residential, single-family structures | Flooding caused by storm water runoff and inadequate drainage |
| | Fredericksted area | Mixed use (residential and commercial) with historic structures and drainage | Flooding caused by storm water runoff and inadequate drainage from upstream sources |
| St. John | Cruz Bay area | Mixed use (residential and commercial) | Flooding caused primarily by storm surge, with some storm water runoff issues |

| Island | Area or Neighborhood | Type of Development | Description of Known Flooding Issues |
|---|---|---|---|
| | Coral Bay area | Mixed use (residential and commercial) | Flooding caused primarily by storm surge, with some storm water runoff issues |

This strategy will focus on these VITEMA-identified areas or neighborhoods, while remaining mindful of the two hundred and twenty-five NFIP-insured properties that provide a significant drain on the National Flood Insurance Fund.

## C.2 REPETITIVE LOSS PROPERTIES MITIGATION PROJECT TYPES

A variety of project types exist that have the potential to mitigate repetitive flood losses. This sub-section provides a general discussion of these project types. Specific recommendations to address repetitive losses in specific areas can be found later in this section.

**Public Education and Outreach**
Insurance industry and emergency management research has demonstrated that awareness of hazards is not enough. People must know how to prepare for, respond to, and take preventive measures against threats from hazards. This research has also shown that a properly run local information program is more effective than national advertising or public campaigns.

Although Territorial efforts to inform the public exist, lives and properties continue to be threatened when segments of the population remain uninformed or chose to ignore the information available. Public education and outreach serves to assist communities with problems experienced from repetitive flooding. Educating the public of these life and property saving techniques should be a high priority task for all levels of government.

**National Flood Insurance Program, Floodplain Management, and Building Codes**
Improved floodplain management, including land use planning, zoning, and enforcement in the Territory can reduce flood related damages for both existing buildings and new development. The use of the NFIP is critical to the reduction of future, repetitive flood damage costs to the taxpayer.

All developments, regardless of the location, require a permit to include buildings, fill, and any other type development. The Territory has the authority to implement and enforce adopted ordinances related to floodplain management, building code and zoning compliance.

The NFIP requires that when the cost of reconstruction, rehabilitation, addition, or other improvements to a building equals or exceeds 50% of the fair market value, then the building must meet the same construction requirements as a new building. Substantially damaged buildings must be brought up to new construction standards. A residence or building damaged so that the cost of repairs equals or exceeds 50% of the structure's fair market value must also be elevated above the Base Flood Elevation (BFE) in flood zones where BFEs are established. This provision applies to the entire jurisdiction of the Territory.

The current, effective Flood Insurance Rate Maps for the Territory were issued on April 16, 2007. The Territory joined the NFIP on October 15, 1980, and is a member community in good standing with the Program.

Within floodplain management as a whole, the education process must play an important role. As noted above, an effective education program should be implemented to show citizens the importance of building codes and ordinances and how cost effective they could be in reducing future damages.

Established through the NFIP, the Community Rating System (CRS) is a program that participants can elect to join. Once a community has joined, policy holders in participating communities receive a discount on their flood insurance premiums. As a result of being part of the CRS, the Territory would have to actively pursue public outreach programs. One of the requirements of CRS is an annual outreach project, such as a Repetitive Loss Outreach Program. This program would focus on repetitive loss areas within the Territory and consists of three main components. The first is to advise the homeowners that they live in a repetitive loss area and could be subject to flooding. The second is to give the property owner appropriate property protection measure guidelines. The third is to make the homeowner aware of the basic facts about Flood Insurance. The Territory is not currently a member of the CRS, but could consider joining the program in the future.

Each community that is a participating community in the NFIP Program is required to have both a well trained municipal floodplain manager and construction code official. The Territory currently meets this requirement. To ensure adequate enforcement of both codes, each community in the NFIP should encourage additional training opportunities for all code enforcement personnel, to include its floodplain manager.

Floodplain management and building codes serve to assist the communities with problems experienced from floods, hurricanes, tornadoes, and thunderstorms/lightning/high winds as well as other lower priority hazards.

The Territory has adopted and currently enforces the International Building Code (IBC), 2009.

**Flood Mitigation Actions**
Retrofitting structures prone to periodic flooding can be an effective mitigation technique to reduce the flood loss of property. Techniques include the elevation of structures, property acquisition, dry flood-proofing, wet flood-proofing, and drainage improvements. Each of these project types is discussed below.

**Elevation**: involves raising a structure on a new foundation so that the lowest floor is above the BFE. Almost any type and size of structure can be elevated, though some types of construction lend themselves more easily to this technique.

A secondary type of elevation is known as a *second-story conversion.* In this type of elevation project, the first or ground floor of a structure is demolished, and a new floor is constructed above the BFE. In the case of an existing 2 story structure, for example, the ground story would be removed, and a new story would be constructed above or on top of the previous second story. This allows for the entire structure to be elevated above the BFE, without causing the structure the strain of traditional elevation.

**Acquisition of Structures**: the *buyout* option is the most effective mitigation technique to reduce the loss of property due to flooding. The owners of repetitive flood loss or flood damaged structures sell their structure and property to the community on a cost share basis for the fair market value of the structure prior to the last flood event. The structure is removed and/or demolished, and a deed restriction is placed on the property for perpetuity, thus removing the structure from future flood damage. This approach is most effective when flood prone structures located within the same vicinity are grouped together and acquired. The remaining property is converted to open space, and is subject to the building and development limitations outlined in

the deed restriction. While the property may be re-developed, it may not be in any manner that impedes the floodplain or violates the terms of the deed restriction.

**Dry Flood-proofing**: is a mitigation technique designed to prevent floodwaters from penetrating the structure. Techniques include the building of floodwalls adjacent to existing walls, the installation of special doors to seal out floodwaters, and special backflow valves for water and sewer lines. Dry flood-proofing includes low cost mitigation measures such as raising air conditioners, cisterns, and water heaters on platforms above the BFE.

**Wet Flood-proofing**: is a mitigation technique designed to allow for the safe entry of floodwaters into a structure, thereby minimizing the flood damage to the structure. Generally, this includes properly anchoring the structure, using flood resistant materials below the BFE, protection of mechanical and utility equipment, and use of openings or breakaway walls. Application of wet flood-proofing as a flood protection technique under the NFIP is limited to enclosures below elevated residential and non-residential structures and to accessory and agricultural structures that have been issued variances by the community.

**Drainage Improvements**: Improving the drainage capacity around roads and low-lying areas is a time-tested technique to mitigate flood damage. Maintenance of drainage canals, swales, ditches, culverts and laterals is essential to maximize their efficiency and continued long term effectiveness. General actions to reduce the effects of flooding include: widening and deepening the canals, cleaning of existing ditches, replacing existing culverts, upgrading pumps, installing check valves and inverts in certain culverts. Maintaining and improving drainage serves to assist the communities with problems experienced from floods, high winds, and severe storms.

**Erosion Mitigation Actions**

With a clear understanding of the erosion hazard, communities can work towards preventing future damages. Some mitigating measures are:

- **Educational Outreach:** develop and conduct educational outreach programs on the effects of coastal erosion as well as on how to minimize future erosion.

- **Erosion Zone Studies**: conduct detailed studies to identify erosion hazard zones and provide direction for future coastal development.

- **Erosion Control / Bank Stabilization:** detailed studies of eroded or erosion-prone areas can provide direction for ways to slow down erosion rates or to otherwise provide for bank stabilization.

- **Beach Restoration** projects can also be undertaken as a means to mitigate this hazard, when erosion occurs in shoreline or beachfront areas.

## C.3 POTENTIAL FUNDING SOURCES

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP), and the Unified Hazard Mitigation Assistance (UHMA) grant program. The UHMA includes the Flood Mitigation Assistance Program (FMA), the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Program (PDM), Repetitive Flood Claims (RFC) and the Severe Repetitive Loss (SRL) grants. All of these programs are administered by VITEMA.

The following is a tabular summary, followed by a more detailed description of programs that are the primary source of federal funding of hazard mitigation projects and activities in the USVI. All of the programs listed below are current or potential sources funding for mitigation projects to address Severe Repetitive Loss properties and concerns.

**TABLE C.4** ***Federally Funded Mitigation Programs***

| Program | Type of Assistance | Availability | Funding Source |
|---|---|---|---|
| **National Flood Insurance Program (NFIP)** | Pre-disaster flood insurance | Any time (pre and post disaster) | National Flood Insurance Program |
| **Flood Mitigation Assistance Program (FMA)** | Cost share grants for pre-disaster planning and flood projects | Annual pre-disaster grant program | FEMA |
| **Hazard Mitigation Grant Program (HMGP)** | Post-disaster cost share grants | Post disaster grant program | FEMA |
| **Pre-Disaster Mitigation Program (PDM)** | Pre disaster mitigation grants | Annual pre-disaster grant program | FEMA |
| **Public Assistance** | Post-disaster aid to state and local governments | Post disaster | FEMA |
| **Community Development Block Grant- Disaster Recovery Funding (CDBG-DR)** | Post disaster aid to state and local governments | Post disaster | U.S. Department of Housing and Urban Development |

The following paragraphs provide additional details regarding these Federal mitigation funding opportunities. Each of these programs is a potential funding source for projects to advance VITEMA's SRL strategy.

**National Flood Insurance Program**

The National Flood Insurance Program (NFIP), established by Congress in 1968, provides flood insurance to property owners in participating communities. This program is a direct agreement between the federal government and the Territory that flood insurance will be made available to residents in exchange for community compliance with minimum floodplain management requirements. Since the typical property insurance policy does not cover flooding, the Territory's participation in the NFIP is vital to protecting property in the floodplain as well as ensuring that federally backed mortgages and loans can be used to finance property within the floodplain.

Pursuant to the Flood Disaster Protection Act of 1973, many forms of federal financial assistance, including disaster assistance and federally regulated loans, related to structures located in the Special Flood Hazard Area (SFHA) are contingent on the purchase of flood insurance. Such federal assistance includes not only direct aid from agencies, but also from federally insured lending institutions. In order for property owners to be eligible for purchasing flood insurance through the federal government, their respective community must be participating in good standing in the NFIP.

Communities participating in the NFIP must:

. Adopt the Flood Insurance Rate Maps as an overlay regulatory district or through another enforceable measure.
. Require that all new construction or substantial improvements to existing structures in the flood hazard area will be compliant with the construction standards of the NFIP and adopted building code.
. Require additional design techniques to minimize flood damage for structures being built in high hazard areas, such as floodways or velocity zones.

**Flood Mitigation Assistance Program (FMA)**

Authorized by the National Flood Insurance Reform Act of 1994 (42 USC 4101, the Flood Mitigation Assistance (FMA) program was created with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).

FEMA provides FMA funds in the form of a grant to assist the Territory in the implementation of measures that reduce or eliminate the long-term risk of damage to buildings and structures insured under the NFIP. Three types of grants are available to the Territory:

- **Planning Grants** to prepare Flood Mitigation Plans. Only NFIP-participating communities with approved Flood Mitigation Plans can apply for FMA Project grants
- **Project Grants** to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures. Applicants are encouraged to prioritize FMA funds for applications that include repetitive loss properties; these include structures with 2 or more losses each with a claim of at least $1,000 within any ten-year period since 1978.
- **Management Cost Grants** for the Territory to help administer the FMA program and activities. Up to ten percent (10%) of Project grants may be awarded for Management Cost Grants

Flood hazard mitigation plans, approved by the Territory and FEMA, are a pre-requisite for receiving FMA project grants. FEMA provides a federal share of up to 75% of the cost of the plan or project while the remaining 25% must come from a non-federal funding source.

FMA is funded through an annual federal appropriation. In Fiscal Year 2010 (FY-10), approximately $32,308,500 was allocated to FMA nationwide. . Previous fiscal years have seen FMA allocations ranging from $28,000,000 to $35,700.000 nationwide.

Some statutory limits exist on the amount of FMA funding a State may receive[1]:

- The total amount of FMA funds provided during any 5-year period shall not exceed $10 million to any State agency or $3.3 million to any community.
- The total amount of FMA funds provided to any State, including all communities located in the State, shall not exceed $20 million during any 5-year period.
- Individual planning grants using FMA funds shall not exceed $150,000 to any Applicant or $50,000 to any sub-applicant. FMA funds only can be used for the flood hazard component of a hazard mitigation plan that meets the planning criteria outlined in 44 CFR Part 201.
- The total planning grant using FMA funds made in any fiscal year to any State and the communities located within the State shall not exceed $300,000.
- No more than 7.5 percent of FMA funds shall be used for planning in any fiscal year.
- A planning grant shall not be awarded to an applicant or sub-applicant more than once every 5 years.

Applicants for FMA funding must submit their applications through the e-Grants system during the application window, as established by the *HMA Unified Guidance.* For FMA, FEMA will conduct a National Technical Review, for all project sub-applications that are forwarded from the initial FEMA review, for the following:

- Cost effectiveness;
- Engineering feasibility and effectiveness; and
- Environmental and Historic Preservation compliance.

**Hazard Mitigation Grant Program (HMGP)**

Unlike the other HMA programs, HMGP is not a nationwide competitive program. Established pursuant to Section 404 of the Stafford Disaster Relief and Emergency Relief Act (PL 100-707), this program provides matching grants (75% Federal, 25% non Federal) for FEMA-approved hazard mitigation projects following a Presidential Disaster Declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from

[1] Note: FEMA may waive the above limits when a major flood-related disaster or emergency is declared pursuant to the Stafford Act.

a disaster. Eligible State, Territorial, local and tribal governments, as well as some non-profit organizations, may apply for the funding. Individual citizens are not eligible to apply, though eligible entities may apply on their behalf.

HMGP is not funded annually. The amount of funding available varies from disaster to disaster. The formula is based on the estimated aggregate grant funding under the Stafford Act assistance programs (Public Assistance, Individual Assistance, and Disaster Unemployment Assistance). The Territory is allocated a percentage of the estimated funding for use as HMGP funds. States and Territories with Standard Mitigation Plans, such as Rhode Island, are allocated the following:

15 % of the first $2,000,000,000
10% of the next $10,000,000,000
7.5% of any amount over $10,000,000,000

For States and Territories with a Standard Mitigation Plan, the total allocation for HMGP cannot exceed $35,333,000,000.

States and Territories with an Enhanced Mitigation Plan are eligible to receive an amount not to exceed 20% of the estimated aggregate grant funding.

The grants are specifically directed toward reducing future hazard losses, and can be used for projects protecting property and other resources against the damaging effects of floods, hurricanes, earthquakes, high winds, and other natural hazards.

Since the creation of the HMA program, significant changes have been made to the program guidance that guides the HMGP. The following illustrates the program guidance for HMGP in recent years:

- For disasters declared prior to 06-01-09, the 1999 *HMGP Desk Reference* is the applicable guidance.
- For disasters declared on or after 06-01-09 and prior to 06-01-10, the *FY-10 HMA Unified Guidance* is the applicable guidance.
- For disasters declared on or after 06-01-10, the *FY-11 HMA Unified Guidance* is the applicable guidance.

In addition to these changes, FEMA also implemented guidance specific to property acquisition projects. FEMA codified Part 80, *Property Acquisition and Relocation for Open Space,* into 44 CFR; the new part became effective for all disasters declared on or after 12-03-07.

**Pre-Disaster Mitigation Competitive (PDM) Program**

The Pre-Disaster Mitigation (PDM) Program was authorized by §203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 US.C. Chapter 68, as amended by § 1 02 of the Disaster Mitigation Act of 2000. Funding for the program is provided by annual appropriation through the

National Pre-Disaster Mitigation Fund to assist States, Territories, Indian Tribal Governments, communities and universities in implementing cost effective hazard mitigation activities that complement a comprehensive mitigation program. All applicants must be participating and in good standing in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area.

44 CFR Part 201, *Hazard Mitigation Planning*, establishes criteria for State, Territorial and local hazard mitigation planning authorized by §322 of the Stafford Act, as amended by §104 of the DMA 2000. After November 1, 2004, states and territories are required to have an approved mitigation plan in order to receive PDM funds for State or Territorial mitigation projects. Therefore, the development and maintenance of State or Territorial mitigation plans is critical to maintaining eligibility for future PDM funding.

Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.

PDM is a part of FEMA HMA Program, and is guided by the *HMA Unified Guidance* for the applicable fiscal year.

The State or Territory (also called the Applicant) submits the prioritized applications to their FEMA Regional Office. Applications will be initially reviewed by FEMA to ensure all minimum requirements are met for the PDM program. FEMA provides additional ranking points for all eligible mitigation planning and project sub-applications on the basis of predetermined, objective, quantitative factors to calculate a final National Ranking Score for each sub-application.
The table below provides the 2011 National Ranking Factors.

| **National Ranking Factors and Point Values** | **Plans** | **Projects** |
|---|---|---|
| The priority given to the sub-application by the Applicant in their PDM grant application. | 40% | 40% |
| Assessment of frequency and severity of hazards. | 20% | NA |
| Whether the Applicant has a FEMA-approved Enhanced State / Tribal Mitigation Plan by the application deadline. | 20% | 20% |
| Community mitigation factors such as Community Rating System class, Cooperating Technical Partner, participation as a FireWise Community, and adoption and enforcement of codes including the International Code Series and National fire Protection Association 5000 Code, as measured by the Building Code Effectiveness Grading Schedule. | 10% | 10% |
| The percent of the population benefitting, which equals the number of individuals directly benefiting divided by the community population. | NA | 10% |
| Whether the project protects critical facilities. | NA | 10% |
| Status of the local sub-applicant as a small and impoverished community. | 10% | 10% |
| TOTAL POINT VALUES | 100% | 100% |

Project and plan applications that are selected for further review are sent for final review by the National Evaluation Panel. These are panels composed of representatives from FEMA, State, Territories, local governments, federally recognized Indian Tribal governments, and other Federal agencies who peer evaluate project and planning sub-applications on the basis of qualitative factors. (Note: Project applications and Plan applications have differing factors, which can be found here: http://www.fema.gov/government/grant/pdm/index.shtm.)

PDM, unlike other HMA programs, is a nationwide, competitive program. While there is no set limit on how much funding a single State, Territory or community may receive, there are restrictions in place, which are as follows:

- Up to $800,000 Federal share may be requested in a sub-application for a planning grant to develop a new hazard mitigation plan.
- Up to $400,000 Federal share may be requested in a sub-application for a planning grant to update a hazard mitigation plan.
- Up to $3 million Federal share may be requested in a sub-application to implement a mitigation project.
- The cumulative Federal award for sub-applications awarded during a single application cycle to any one Applicant shall not exceed 15 percent of the total appropriated PDM program funds for that application cycle.

The amount of funding allocated for PDM fluctuates from year to year:

| | |
|---|---|
| FY-10 | $100,000,000 |
| FY-09 | $ 90,000,000 |
| FY-08 | $114,000,000 |
| FY-07 | $100,000,000 |
| FY-06 | $ 50,000,000 |

**Public Assistance Program (Section 406 Mitigation)**

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to State, Territorial, Tribal and local governments, and certain types of private non-profit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.

Through the PA Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain private non-profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.

The Federal share of assistance is not less than 75% of the eligible cost for emergency measures and permanent restoration. The grantee (usually the Territory) determines how the non-Federal share (up to 25%) is split with the sub-grantees (eligible applicants).

After a natural or man-made event that causes extensive damage, FEMA coordinates with the Territory to implement the Public Assistance Grant Program. The funding process consists of the following steps:

- Preliminary Damage Assessment (PDA)
- Presidential Disaster Declaration
- Applicants' Briefing by Grantee
- Submission of Request for Public Assistance by Applicant
- Kick-off Meeting with Public Assistance Coordinator (PAC)
- Project Formulation and Cost Estimating
- Project Review and Validation
- Obligation of Federal Funds and Disbursement to Sub-grantees
- Appeals and Closeout

The Public Assistance (PA) Program is administered through a coordinated effort between the Federal Emergency Management Agency (FEMA), the Territory (grantee), and the applicants (sub-grantees).

The Robert T. Stafford Disaster Relief and Emergency Assistance Act provides FEMA the authority to fund the restoration of eligible facilities that have sustained damage due to a Presidentially declared disaster. Commonly called Section 406 Mitigation, this program provides some mitigation funding within the context of the Public Assistance Program.

Section 406 Mitigation provides discretionary authority to fund mitigation measures in conjunction with the repair of the disaster-damaged facilities. These opportunities usually present themselves during the repair efforts. The mitigation measures must be related to eligible disaster-related damages and must directly reduce the potential of future, similar disaster damages to the eligible facility. Normally, this work is performed on the parts of the facility that were actually damaged by the disaster. In some instances, an eligible mitigation measure may not be an integral part of the damaged facility.

There is no pre-set limit to the amount of Section 406 funds a community may receive. Section 406 Mitigation measures must be determined to be cost effective. Any one of the following means may be used to determine cost-effectiveness:

1. Mitigation measures may amount to up to 15% of the total eligible cost of the eligible repair work on a particular project.
2. Certain mitigation measures have been determined to be cost effective, as long as the mitigation measure does not exceed 100% of the eligible cost of the eligible repair work on the project.
3. For measures that exceed the above costs, the Grantee or sub-grantee must demonstrate through an acceptable benefit/cost analysis methodology that the measure is cost effective.

## C.4 REPETITIVE LOSS PROPERTIES MITIGATION STRATEGIES

*This sub-section provides specific mitigation strategy recommendations and suggestions for the VITEMA- and DPNR-identified repetitive loss areas throughout the Territory. A discussion of the area suffering repetitive flood damage is included, to provide a basis for the recommendations and suggestions.*

In lieu of property-specific information from FEMA, this strategy was prepared based on local knowledge regarding areas of repetitive flood loss. Staff members from the Department of Permitting and Natural Resources (DPNR) Permitting Department and VITEMA were consulted, and a list of areas or neighborhoods known to be affected by repetitive flood loss was prepared. Each of these areas was then visited and assessed, in preparation for the development of this strategy.

It must be noted that the following strategies are recommendations only. No site-specific engineering or design has been conducted, nor has a detailed hydrology and hydraulic study been prepared. Prior to implementation of any of these recommendations, detailed engineering and analysis must occur.

For an overview of the areas designated as repetitive loss through this methodology, please refer to Table D-3.

### Area-Specific Repetitive Loss Mitigation Strategies – St. Thomas

**Charlotte Amalie: Main Street Area**

This area is located in the heart of Charlotte Amalie, and is primarily comprised of commercial structures. Many of these structures are historic. The primary source of flooding is storm surge, though storm water runoff issues do exist. The runoff issues result from debris and/or inadequate drainage, in the form of undersized guts. The area has also been known to flood during exceptionally high tide events. During storm surge events, the flooding occurs, on average, inland as far as two streets back from the waterfront. The buildings in the area are predominantly slab on grade construction with little structure elevation for flood protection.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Wet flood-proofing of existing structures
- Dry flood-proofing of historic structures
- Drainage improvements

**Turpentine Run Area**

This mostly commercial area is located outside of Charlotte Amalie. Flooding occurs due to inadequate drainage from storm water runoff, usually from overtopping of a large gut along the roadway. When the gut overflows, the road and businesses suffer flood damage. The structures in the area date mostly to 1990s; none are considered historically significant. While other access points to the area do exist, the road that floods is the main thoroughfare.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices

- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**Nadir Area**

This residential area is home to 70-80 single family structures, primarily consisting of slab on grade construction. Shallow, roadside guts provide the only drainage for storm water runoff, which is the source of flooding in this area.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**Bovoni Area**

The residential community of Thomasville, in the Bovoni area, has storm water runoff issues similar to those found in the Nadir area. Though the Bovoni/Thomasville area is a bit hillier, the same inadequate drainage – comprised of shallow, roadside guts – is found in this neighborhood of 50-60 single family structures and an apartment community. Though the apartment community has been known to experience flooding, the single family structures were identified as the repetitive loss area.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**Bolongo Bay Area**

This residential area is found in rather hilly terrain. The source of flooding for this area is storm water runoff, which results in frequent flooding of the roadway. One single family residential structure, located close to the road, is especially prone to flooding. Storm water runoff flows down the hill and along the road, resulting in too great of a flow for the small gut along the roadway to effectively contain.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices

- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**Smith Bay Area**
This area is comprised of mixed use structures, with the primary flooding concern being for the residential structures. The entire area is flood-prone, as the small, inconsistent gut along the roadway provides insufficient drainage for storm water runoff, resulting in channeling of runoff along the roadway. The structures of particular concern are the 10-15 houses that are sited lower than the roadway, and are especially prone to flooding.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**St. Peter/Northside Village Area:**
In this hilly, residential area, there is a single family structure that is known to have suffered repetitive flood losses. A small gut along the road provides only drainage for storm water runoff, and is inadequate to contain the flow of water. Floodwaters spill out of the gut and cross the road, rushing over/under the guardrail and inundating the structure.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Drainage improvements

### Area-Specific Repetitive Loss Mitigation Strategies – St. Croix

**Gallows Bay/Spring Valley Area**
This mixed use area is comprised of residential structures on top of the hills and commercial properties below the houses. The source of flooding in the area is storm water runoff, with sheet flow occurring down the hill. The flow typically channels through the street, and often enters the open sewer system under the street, leading to contamination issues. Due to the relative flatness of the road, flood waters typically stand for a day, disrupting

passage and access to the ferry. In addition, new bypass highway is being constructed; this new highway will also use the existing drainage system.

To mitigate this repetitive loss area, the following strategy is recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Drainage improvements

**La Grand Princess Area**

This residential area has long-standing flooding issues, dating back more than 30 years. Development of the 200-300 affected homes this area was completed prior to the development of many areas upstream. Many of the structures in the area are of slab on grade construction, though some have been elevated for flood protection. Due to inadequate drainage for storm water runoff, flood waters funnel down the road to the beach. Throughout the area, structures bear visible signs of repetitive high water, with evident high water marks on structures. Many of the homes were built on filled foundations. In particular, one structure, located next to a gut, has experienced repetitive flooding so often that the house now has evident structural issues, including cracking of walls and foundation.

In addition, the area experiences storm surge flooding during tropical storm and hurricane events. In particular, the Hibiscus Hotel, a beachfront property, has made several insurance claims in the last few years, with damages resulting from storm surge. It should be noted that there are no dunes on the beach to provide flood protection, though a small sea wall (approximately 6' high) was constructed at edge of property.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**Sion Hill Area**

This area is mixed use, but is largely comprised of residential structures. A major gut exists in the area, which provides drainage for storm water runoff. The road is higher than the gut, which results in flooding of the gut. Previous attempts to correct the issue have resulted in increased flooding. Some residents have erected small flood barriers around their property (often attached to fences around the property), causing increased flooding downstream. In previous flood events, water has moved throughout the area with enough force to dislodge a septic system.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures

- Drainage improvements

**Estate Castle Area**

This residential area experiences major flooding from a development upstream, and is often saturated with storm water runoff. Many of the approximately 100 homes in the area were constructed below grade. The area is prone to standing water in the road, as evidenced by the large and numerous potholes. Just to the east of the area are several acres of impervious surface, which results in a fast moving sheet flow of flood waters. Property owners and residents have been trapped in their houses and/or had no access to egress. A retention pond was placed in the area to alleviate some of the drainage issues, but – due to poor maintenance - it was eventually filled in with sediment and is now a small animal farm. Residents of the area have indicated previously that they wanted the drainage issues in the area resolved, but that they were unwilling to give up any private property to easements for drainage improvements.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**Estate Barron Spots Area (including Strawberry Estate, Strawberry Hill, and Estate La Reine)**

This large residential area, which is home to several hundred houses in each development, experiences significant storm water runoff flooding from multiple channels upstream, which are compressed into a single channel downstream, leading to sheet flow and fast moving water in the area. A single culvert exists downstream, which is obviously undersized. It must be noted that more permits are issued in this general area than anywhere else on the island, and that the primary foundation type in the area is slab on grade. Many structures in the area bear evidence of repeated flooding via visible high water marks.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

**Mon Bijou Area**

This residential area experiences significant flooding resulting from channelization of storm water runoff into the natural gut, which routinely results in flows that exceed the capacity of the natural gut. This has led to serious erosion of the gut, and resulted in severe foundation damage and drifting of structural elements of the residential structures that are in the area. Visible evidence exists of shifted or destabilized retaining walls and concrete driveways. As the erosion progresses, the damage to structures will likely continue. Approximately 8-10 homes are affected and most are believed to be uninsured.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Erosion control /Bank stabilization of the gut
- Drainage improvements

**Lorraine Village Apartments Area**

This residential housing complex consists of apartment homes of a split level design and some single family residences. Flood waters have entered several units throughout the complex. A drainage gut runs through the complex, crossing paved areas, and often overflows due to inadequate drainage and capacity. This overflowing has resulted in significant erosion of the area around the gut; one single family structure is in jeopardy of eventually falling into the gut due to foundation destabilization.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Erosion control /Bank stabilization of the gut
- Drainage improvements

**William's Delight Area**

This large residential area is home to more than 300 single family structures, and has experienced significant flooding for many years. The primary cause of flooding is undersized or inadequate drainage of storm water runoff in the area. A significant drainage project has been underway in the area for several years. The project seeks to install underground drainage piping to direct storm water runoff to the gut; the project has been partially completed. As a part of the project, the roadway surfaces were removed, leaving unpaved roads throughout the neighborhood. Funding is currently being sought to repave the roadways and to finish the drainage project.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Elevation of existing structures
- Drainage improvements

**Frederiksted Area**

This historical, mixed use district contains buildings and drainage dating to the 1700s. Most buildings are elevated, windows to modern base flood elevations, and have been so since their original construction. The

existing storm water and surge drainage system (which is also original to the area) would be sufficient for the area if not for impervious surfaces and increased runoff from upstream. Improvements to drainage upstream would likely alleviate storm water runoff flooding in the area.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Drainage improvements (upstream)

### Area-Specific Repetitive Loss Mitigation Strategies – St. John

**Cruz Bay / Enighed Pond Area**

This mixed use area is located in an area subject primarily to storm surge inundation, though some storm water runoff issues do exist. Repetitive flooding of a critical facility (electrical substation) has occurred, as well as repetitive flooding of roads and recreation areas.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Elevation of existing structures
- Drainage improvements

**Coral Bay Area**

This mixed use area is located in an area subject primarily to storm surge inundation, though some storm water runoff issues do exist. The area is prone to debris and washouts from flooding, and experiences significant runoff and erosion as a result of insufficient storm water management.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Elevation of existing structures
- Drainage improvements

## C.5 SUMMARY OF REPETITIVE LOSS PROPERTIES MITIGATION STRATEGY

Two primary sources of flooding exist in the US Virgin Islands – storm surge inundation and inland flooding. As an island territory, storm surge inundation will continue to be a flooding source for the built environment on all three islands. Mitigation of storm surge inundation should be considered in terms of both individual structures and area drainage systems. Flooding includes both coastal flooding and inland flooding; the later often associated with inadequate storm drain systems.

Any drainage improvements should take careful consideration of both the upstream and downstream effects, and should incorporate the natural drainage and floodplain patterns of the island wherever possible. Significant drainage improvements in the identified areas would have the potential to alleviate a significant portion of the existing storm water runoff and storm surge inundation flooding concerns.

Changes to FEMA hazard mitigation grant program since the last Plan Update include the elimination of the Severe Repetitive and Repetitive Loss Claim grant programs. To encourage efforts by states and local jurisdictions to reduce repetitive loss damages, FEMA has reduced the cost share requirement for HMA grant funding if the action directly reduces repetitive losses. In this Plan Update, VITEMA has emphasized administrative, planning, and hazard mitigation actions that will help achieve a reduction of repetitive losses throughout the Territory.

Although the Flood Mitigation Assistance (FMA) grant program is the most closely related to reducing the number of repetitive loss properties, the Repetitive Loss Strategy presents a number of FEMA and other funding sources that should be considered to provide hazard mitigation funds. There are very few severe repetitive loss properties in the USVI; hence, the major effort should be focused on repetitive loss properties, currently estimated at 225 properties.

# APPENDIX D MITIGATION ACTION ASSESSMENT MATRIX: REVIEW OF 2011 MITIGATION ACTIONS

## REVIEW OF 2011 PROGRAMMATIC ACTIONS

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| USVI-1 | VITEMA to work with DPW to focus annual budget and priorities to remove built up sediment, debris and maintain natural guts, roadside ditches, drainage channels and storm drains in areas that are designated in this Plan as Repetitive Loss Mitigation Strategy (RLMS area). | | | X | |
| USVI-2 | Publicize the availability of print material on hazard data and hazard mitigation tools to professional associations, interest groups, and the private sector. | | X | | VITEMA staff reductions and resource constraints necessitate removing this action over the next Plan Update cycle |
| USVI-3 | Strengthen partnerships with the Office of the Governor and media to disseminate information to the general public on hazard mitigation programs and importance of reducing number of USVI repetitive loss properties | | | X | |
| USVI-3 | Distribute and require the use of maps that were developed as part of the flood insurance study that delineate natural drainageways (guts) that exceed a specified cross-section or flow in cubic feet per second to appropriate DPNR and DPW staff responsible for development review or engineering design of flood drainage improvement works to prevent encroachment of new development or alteration of natural guts unless necessary for the correction of existing flooding problems. | | | X | |
| USVI-6 | Construct a database management program and develop procedures to collect information on and to track **repetitive loss** properties in the Territory. | | | X | |
| USVI-7 | Define and implement arrangements for the collection of data on **Landslides** that can affect the Territory, including information on location (maps), history, and probability of | | | X | USVI-7, USVI-8, and USVI-9 were combined into one programmatic action in the 2014 Plan Update |

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| | hazard events. | | | | |
| USVI-8 | Define and implement arrangements for the collection of data on the **Wildfire** that can affect the Territory, including information on location (maps), history, and probability of hazard events. | | X | | See above |
| USVI-10 | Define and implement arrangements for the collection of data on **Drought** that can affect the Territory, including information on location (maps), history, and probability of hazard events. | | X | | See above |
| USVI-11 | Construct a database management program and develop procedures to track mitigation project progress and effectiveness from project award to project completion so as to provide a record on the aggregate actual costs avoided of implemented mitigation projects in the territory. | | | X | |
| USVI-12 | Conduct follow-up activities to engage members of hazard mitigation committees in an annual review of planning and implementation activities under their agency's responsibility | | X | | Removed because this action was considered in the 2014 Plan Update as a necessary part of program implementation, not requiring a specific mitigation action (see discussion in Section 6 Plan Maintenance). |
| USVI-5 | Develop conceptual retrofit or relocation mitigation projects, including preliminary cost estimates, for retrofitting or relocating essential infrastructure and critical facilities that can be undertaken following a future disaster event (primarily hazard mitigation funding sources – PDMC, HMGP,etc.). | | X | | Removed in the 2014 Plan Update due to VITEMA staff and resource constraints. |
| USVI-4 | Develop worksheets for Government agency facility managers to gather relevant information necessary to support applications to seek federal hazard mitigation funding where appropriate. | | X | | Mitigation action removed because considered standard operating procedure for VITEMA not requiring a specific mitigation action. |

## REVIEW OF 2011 ISLAND SPECIFIC ACTIONS, ST. THOMAS

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| STT-23 | Installation of High Impact Hurricane windows at the Department of Public Works (HMGP-1807). | X | | | |
| STT-22 | Installation of High Impact Hurricane windows at the Department of Property and Procurement (HMGP-1807). | X | | | |
| STT-24 | Installation of High Impact Hurricane windows at the Department of Education (HMGP-1807). | X | | | |
| STT-25 | Installation of High Impact Hurricane windows at the Department of Human Services (HMGP-1807). | X | | | |
| STT-8 | Construct drainage improvements on Turpentine Run (Brookman Road) to alleviate localized flooding. | | | X | |
| STT-9 | Construct drainage improvements to improve the capacity of the drainage system by Yvonne Bowsky Elementary School (Peace Corp) to alleviate localized flooding. | | | X | |
| STT-10 | Construct drainage improvements to improve the capacity, and clean, the storm water drainage system in Frydenhoj (next to and across from ball field) to alleviate localized flooding and damage of private property. | | | X | |
| STT-17 | Resolve flooding problems at Subbase Entrance. Pursue Phase II drainage improvements which include the installation of properly-sized culverts from Bellows across Veterans Drive to connect to Phase I drainage improvements. | | | X | |

| | | | | | |
|---|---|---|---|---|---|
| STT-6 | Construct drainage improvements on Rt. 30 adjacent to Bolongo Bay to alleviate flooding to residential areas and beach erosion. | | | X | |
| STT-13 | Enlarge box culverts, stormdrains, and improvements to open channels from Veterans Drive to the Bay along the east edge of Frenchtown in southwest Charlotte Amalie (Frenchtown Drainage East), in order to resolve flooding, traffic access and business interruption, by providing 100-year flood protection. | X | | | |
| STT-11 | Pursue the acquisition of land for the relocation of the Downtown Fire Station that is susceptible to storm surges and tsunami. | | X | | Current USVI Territory financial issues necessitate removing this action for the upcoming Plan Update cycle. |
| STT-7 | Construct drainage improvements for major drainage channel that conveys flood waters from the surrounding Altona and Anna's Fancy areas to resolve recurrent flooding after heavy rainfall events. | | | X | |
| STT-12 | Expand and reinforce communication infrastructure that is being implemented by BIT to mitigate damages from hurricanes to ensure rapid recovery and return to normal service. | | | X | |
| STT-21 | Replace and improve drainage infrastructure at Food Center in order to resolve flooding of roads, businesses, while addressing potential secondary impacts to wetlands. | | | X | |
| STT-3 | Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Radets Gade from Main Street to Veterans Drive that affect businesses. | X | | | |
| STT-1 | Construct Lindberg Estates, Phase IV Drainage Project north through Kirwin Terrace Public Housing Units. | | | X | |

| | | | | | |
|---|---|---|---|---|---|
| STT-14 | Implement drainage improvements to resolve the flooding problems at Coki Point and Smith Bay Roads, and, improvements to open channels draining through the Resort Complex into Water Bay (Smith Bay Basin) to resolve localized flooding problems that periodically close roads, create traffic hazards, prevent emergency vehicle and public access, and cause damage to adjacent businesses and road pavement. | | | X | Modified in the 2014 Plan Update to include a hydrological study to identify potential sub-basin mitigation measures. |
| STT-15 | Construct drainage improvements to secondary road that provides access to Caret Bay West. Improvements could include paving and/or providing proper roadside drainage and properly-sized culverts where appropriate to carry stormwater across the road to minimize erosion of the road surface. | | | X | |
| STT-5 | Improve drainage infrastructure along Rt. 30 Estate Hope / Fortuna to eliminate flooding of nearby residences in Fortuna 3C Subdivision. | | | X | |
| STT-18 | Complete Installation of Hurricane Shutters at main police station in Charlotte Amalie. | | | X | |
| STT-19 | Improve drainage infrastructure along Hospital Gade from Antonio Jarvis School to the Police Station on Verteran's Drive, paying particular attention to the intersection of Hospital and Kongens Gade (Moravian Church and Zoras). | | | X | |
| STT-20 | Replace and improve drainage infrastructure along Rt. 33 (Estate Dorethea). | | | X | |
| STT-2 | Pursue road reconstruction and drainage improvements to resolve recurrent flooding on Commandant Gade Gut (Garden Street) from Bunker Hill to Veterans Drive that affect businesses and emergency access. | | | X | |

| | | | | | |
|---|---|---|---|---|---|
| STT-4 | Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Storre Tvaer Gade from Main Street to Veterans Drive that affect businesses. | X | | | |
| STT-16 | Harden WAPA Substations. Design and construction of hardened switchgear buildings at the East End and Tutu Substations. | | | X | |

## REVIEW OF 2011 ISLAND SPECIFIC ACTIONS, ST. CROIX

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| STX-17 | Install storm shutters at the American Red Cross (HMGP-1807). | X | | | |
| STX-18 | Install storm shutters Emile Henderson, Sr. Fire Station (HMGP-1807). | X | | | |
| STX-19 | Install Roll-Up Doors at the Rencelier I. Gibbs Fire Station (HMGP-1807). | X | | | |
| STX 21 | Install Fabric Shutter system at Henry E. Rohlsen Airport (HMGP-1807). | X | | | |
| STX-20 | Implement and improve storm water drainage infrastructure to relieve flooding at the Alfredo Andrews School and adjacent low-lying areas. | | | X | |
| STX-10 | Resolve flooding problems and improve storm water drainage infrastructure in the "Grove at La Reine". | | | X | |
| STX-9 | Conduct a hydrological study of the St. Croix watersheds with particular attention given to the La Grange, Prosperity, Bethlehem and Salt River watershed basins. Attention should focus on upgrading inadequate drainage systems focused on reducing the impact of flooding. | | | X | |
| STX-3 | Perform assessment of flooding problems within La Grande Princess Estate. Approximately 50 of 250 NFIP-insured losses in St. Croix (one in five repetitive losses) occur in La Grande Princess. Eighty two properties were identified as being in the 100 year flood plain and the potential for acquisition, structural solutions, and nonstructural control measures to reduce repetitive losses to residences should be assessed. | | | X | |
| STX-15 | Improve Recovery Hill Water Storage Tanks. Install wind girders to reinforce against hurricane storm winds. | | | X | |
| STX-7 | Improve drainage system to along Melvin H. Evans Highway in the area west of Williams Delight Stop Light and Carlton. Extend drainage system to connect with drainage | | | X | |

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| | improvements in Williams Delight Community. | | | | |
| STX-14 | Conduct feasibility study and implement and provide emergency power generator units for all pumping stations on St. Croix. | | | X | |
| STX-4 | Conduct a hydrological study of the Christiansted watershed or catchment area with particular attention given to the sub-watersheds of Spring Gut and Water Gut to determine technically feasible and cost effective structural solutions to address the flooding problem in Christiansted. | | | X | |
| STX-5 | Resolve flooding problems and improve stormwater drainage infrastructure for "Spring Gut" all the way to Gallows Bay. | | | X | |
| STX-6 | Resolve flooding problems and improve stormwater drainage infrastructure for Tide Village by implementing a low water crossing to divert surface run-off into the natural gut. | | | X | |
| STX-11 | Pursue equipment anchoring program for the Richmond Electrical Generating Plant. Anchor critical equipment in the Plant to mitigate damages caused by earthquake, hurricane-strength winds, tsunami and storm surge. | | | X | |
| STX-16 | Improve Various Water Storage Tanks throughout the island. Install flexible connectors at multiple water storage tanks to permit pipe flexibility during earthquake events and ensure rapid recovery and normal service. | | | X | |
| STX-1 | Pursue Christiansted Gut USACE Section 205 Project. Preliminary feasibility phase currently underway by the Corps to determine whether technically feasible and cost effective solutions exist to reduce flood damages in residential and business areas adjacent to King Cross Street. | | | X | |
| STX-8 | Construct a retention pond at the property line of White Bay and the National Park Service reserve within the localized depression. | | | X | |

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| STX-12 | Construct drainage improvements at the Ricardo Richards Elementary School at Estate Barren Spot near Melvin H. Evans Highway (Route 66). | | | X | |
| STX-13 | Improve Water Distribution Pump Stations at Concordia and Adventure. | | | X | |
| STX-2 | Perform assessment of adjacent drainage basins that flow into Estate Williams Delight to identify alternate routing of surface runoff. | | | X | Modified in the 2014 Plan Update to include consideration of a stormwater detention pond below Blue Mountain. |

## REVIEW OF 2011 ISLAND SPECIFIC ACTIONS, ST. JOHN

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| STJ-10 | Install Storm shutters at the DeCastro Health Clinic (HMGP 1807) | X | | | |
| STJ-11 | Conduct a hydrological study of Coral Bay watershed to propose technically feasible and cost-effective solutions to flooding problems in Coral Bay. | | | X | |
| STJ -12 | Clean Gut at Westin Hotel | X | | | |
| STJ-6 | Provide an alternate power generation substation for Coral Bay to ensure that there is power source or all public services and critical facilities on the east end of the island. | | | X | |
| STJ-5 | Increase fuel capacity of the Myra Keating Health Clinic Emergency power generator unit. | | | X | |
| STJ-1 | Construct drainage improvements to eliminate localized flooding at the lower end of “Carolina Gut” at Little Plantation (Across from Dominos Gas Station) where natural storm flows in the catchment area have been altered by construction and improper siting of structures. | | | X | |
| STJ-2 | Construct drainage improvements to eliminate localized flooding at Pond Mouth at intersection of Rt. 102 and Rt. 105. | | | X | |
| STJ-4 | Implementing a slope stabilization program to reduce damage and blockage of roads during wind storm and flooding events. A program establishment of more stable and cut and fill slopes, removal of material that may be subject to landslide and rock fall events, re-vegetation, of disturbed slopes, etc. Area of concern: Bordeaux Mountain Road and Centerline Road (Between Mile 6 and Mile 7 and (Between Reef Bay and Mile 5)) that periodically closes the road during major storm events. | | | X | |

| Action | Description | Action Completed | Action Removed | Action Remains Valid | Comment |
|---|---|---|---|---|---|
| STJ-9 | Construct underground feeders from the St. John substation to various termination points within Cruz Bay to mitigate damages to hurricane winds and ensure rapid recovery and return to normal service. | | | X | |
| STJ-7 | Improve drainage infrastructure (Box Culverts) at WAPA building and treatment plant, while addressing potential secondary impacts to wetlands. | | | X | |
| STJ-3 | Construct drainage improvements to eliminate localized flooding along Route 20 southbound in Coral Bay (Estate Carolina). | | | X | |
| STJ-8 | Coordinate with the National Park Service for the construction of appropriate drainage system improvements to eliminate localized flooding along Route Rt. 20 in Maho Bay. | | | X | |

Hazard – type of hazard
Name – name of facility
Facility Type – type of facility
Damage Ratio – percentage of losses expected based on the defined hazard event used in t he risk assessment
Loss to Structure – estimated economic losses to the facility based on the risk assessment.
Prominent Vulnerability – General characteristics that add to a buildings vulnerability to a certain hazard. These may include:

- Well defined building types (fall into categories).
- Individual structures have been seen and scored; damage curves are adjusted by score.
- Most structures are on predominantly flat land or gently sloping ground.
- Facilities are well maintained.
- Hazard level and exposure value for each individual structure is unique.

## ST. THOMAS

| Hazard | Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| **Earthquake** | DOE Complex | Government Building | 1.00 | $14,191,260 | UNREINFORCED MASONRY |
| | Ivanna Eudora Kean High School | School | 1.00 | $34,755,137 | UNREINFORCED MASONRY |
| | Office of Management and Budget | Government Building | 1.00 | $2,851,242 | UNREINFORCED MASONRY |
| | West Indian Corporation Dock | Port | 1.00 | $2,660,861 | UNREINFORCED MASONRY |
| | St Thomas Assemblies of God Church | Refuge | 1.00 | $2,458,636 | UNREINFORCED MASONRY |
| | Tutu Fire Station - Lima | Fire Station | 1.00 | $2,431,318 | UNREINFORCED MASONRY |
| | Department of Public Works | Government Building | 1.00 | $2,270,602 | UNREINFORCED MASONRY |
| | VI Fire Service (Ft. Christian) | Fire Station | 1.00 | $1,862,603 | UNREINFORCED MASONRY |
| | Government House | Government Building | 1.00 | $10,608,539 | UNREINFORCED MASONRY |
| | Lt. Governors House | Government Building | 1.00 | $8,592,916 | UNREINFORCED MASONRY |
| | Crime Prevention/Community Relations Bureau | Police Station | 0.99 | $422,345 | UNREINFORCED MASONRY |

| Hazard | Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| | Zone A Police station | Police Station | 0.99 | $9,227,794 | UNREINFORCED MASONRY |
| | Queen Louise home | Hospital/Clinic | 0.95 | $1,037,116 | UNREINFORCED MASONRY |
| | Property Procurement | Government Building | 0.94 | $6,689,467 | UNREINFORCED MASONRY |
| | VI Legislature | Government Building | 0.94 | $5,058,909 | UNREINFORCED MASONRY |
| | WAPA Administration Building | Government Building | 0.90 | $6,425,784 | UNREINFORCED MASONRY |
| | Bluewater Bible College | Refuge | 0.86 | $21,090,525 | UNREINFORCED MASONRY |
| | WAPA Fuel Tanks | Utility | 0.83 | $6,458,179 | Not to Code |
| | Chief of Police | Police Station | 0.83 | $1,126,875 | UNREINFORCED MASONRY |
| | WAPA Subbase Plant | Power Stations | 0.81 | $24,452,797 | Highly Irregular |
| | Sea View Nursing Home | Hospital/Clinic | 0.80 | $3,494,714 | Precode on Slope |
| | Charlotte Amalie High School | School | 0.79 | $40,034,670 | Precode and Irregular |
| | Lucinda Millin Home for the Elderly | Hospital/Clinic | 0.71 | $7,253,342 | Precode |
| | Fire/Police Station | Fire Station | 0.66 | $437,602 | Trailer w/o foundation |
| | Mangrove Lagoon Treatment Plant | Utility | 0.65 | $35,571,087 | Irregular or on slope |
| | East End Health Clinic | Hospital/Clinic | 0.63 | $370,891 | Located in re-entrant corner of building |
| | Bovoni | Utility | 0.63 | $727,901 | Irregular, precode |
| | Public Safety - Zone C | Police Station | 0.62 | $254,951 | Precode on corner of building |
| | WAPA | Utility | 0.61 | $236,049 | Precode |
| **Hurricane** | WAPA Administration Building | Government Building | 0.94 | $6,729,478 | Poor Condition, 3 Story Wood Frame |
| | Property Procurement | Government Building | 0.94 | $6,729,478 | Poor Condition, 3 Story wood frame |
| | Bassanio David Police Dept. | Police Station | 0.81 | $401,546 | Precode |
| | VI Fire Service (Ft. Christian) | Fire Station | 0.78 | $1,445,724 | Precode |
| | Crime Prevention/Community Relations Bureau | Police Station | 0.75 | $317,578 | Precode |

| Hazard | Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| | Department of Public Works | Government Building | 0.73 | $1,652,556 | Near debris generation source |
| | VI Legislature | Government Building | 0.72 | $3,906,915 | On Water's edge, precode foundation |
| | Bluewater Bible College | Refuge | 0.72 | $17,681,827 | Large surface area on steep slope |
| | DOE Complex | Government Building | 0.71 | $10,078,012 | Precode |
| | Nisky Moravian Church | Refuge | 0.71 | $3,469,564 | Large surface area with precode walls |
| | Office of Management and Budget | Government Building | 0.70 | $1,990,205 | Precode walls |
| | Government House | Government Building | 0.69 | $7,300,025 | Precode walls |
| | Lt. Governors House | Government Building | 0.69 | $5,913,020 | Precode walls |
| | St Thomas Assemblies of God Church | Refuge | 0.68 | $1,670,461 | Precode walls |
| | West Indian Corporation Dock | Port | 0.68 | $1,797,130 | On Water's edge, precode foundation |
| | Tutu Fire Station - Lima | Fire Station | 0.67 | $1,617,592 | Precode walls |
| | Ivana Eudora Keah High School | School | 0.65 | $22,702,759 | Large exposed area on hillside |
| | Queen Louise home | Hospital/Clinic | 0.64 | $699,474 | Precode walls |
| | Sea View Nursing Home | Hospital/Clinic | 0.62 | $2,696,569 | Large exposed area on hillside |
| | Zone A Police station | Police Station | 0.59 | $5,508,291 | Precode walls |
| **River Flood Losses** | Lt. Governors House | Government Building | 0.98 | $8,448,766 | Precode walls |
| | Property Procurement | Government Building | 0.98 | $7,009,347 | Precode walls |
| | Tutu Fire Station - Lima | Fire Station | 0.95 | $2,309,752 | Drains to building |
| | Queen Louise home | Hospital/Clinic | 0.95 | $1,038,091 | Precode walls |
| | Crime Prevention/Community Relations Bureau | Police Station | 0.95 | $404,451 | Poor drainage |
| | DOE Complex | Government Building | 0.85 | $12,062,571 | Vulnerable utilities, poor drainage |
| | VI Legislature | Government Building | 0.85 | $4,597,649 | Precode walls |
| | Office of Management and Budget | Government Building | 0.85 | $2,423,555 | Precode walls |

| Hazard | Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| | VI Fire Service (Ft. Christian) | Fire Station | 0.82 | $1,527,334 | Precode walls |
| | Chief of Police | Police Station | 0.80 | $1,092,727 | Precode walls |
| | VI National Guard | Government Building | 0.70 | $7,258,221 | Poor drainage |
| | Human Services (food) | Government Building | 0.70 | $645,702 | Precode foundation |
| | Public Safety - Zone C | Police Station | 0.65 | $267,623 | Poor drainage |
| | Mangrove Lagoon Treatment Plant | Utility | 0.65 | $35,513,628 | Poor drainage |
| | Bovoni | Utility | 0.65 | $749,476 | Poor drainage |
| | Charlotte Amalie High School | School | 0.60 | $30,260,132 | Poor drainage |
| Tsunami | DOE Complex | Government Building | 1.00 | $14,675,325 | Too close to shore |
| | Mangrove Lagoon Treatment Plant | Utility | 1.00 | $50,850,000 | Too close to shore |
| | AA Farley Justice Center | Government Building | 1.00 | $44,025,974 | Too close to shore |
| | AA Farley Justice Center | Police Station | 1.00 | $2,948,498 | Too close to shore |
| | WAPA Subbase Plant | Power Stations | 1.00 | $49,720,000 | Too close to shore |
| | Lucinda Millin Home for the Elderly | Hospital/Clinic | 1.00 | $10,566,234 | Too close to shore |
| | WAPA Administration Building | Government Building | 1.00 | $7,396,364 | Too close to shore |
| | Property Procurement | Government Building | 1.00 | $7,396,364 | Too close to shore |
| | VI Port Authority (Blyden Dock) | Port | 1.00 | $6,420,455 | Too close to shore |
| | VI Legislature | Government Building | 1.00 | $5,593,500 | Too close to shore |
| | Office of Management and Budget | Government Building | 1.00 | $2,948,498 | Too close to shore |
| | West Indian Corporation Dock | Port | 1.00 | $2,751,623 | Too close to shore |
| | VI Fire Service (Ft. Christian) | Fire Station | 1.00 | $1,926,136 | Too close to shore |
| | Bovoni | Utility | 1.00 | $1,192,370 | Too close to shore |
| | Crown Bay Dock (VIPA) | Port | 1.00 | $963,068 | Too close to shore |

| Hazard | Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| | Crime Prevention/Community Relations Bureau | Police Station | 1.00 | $440,260 | Too close to shore |
| | Human Services (food) | Government Building | 1.00 | $953,896 | Too close to shore |
| | WAPA Fuel Tanks | Utility | 1.00 | | Too close to shore |
| | WAPA | Utility | 1.00 | $399,536 | Too close to shore |
| | Ivana Eudora Keah High School | School | 1.00 | $35,940,638 | Too close to shore |
| | Charlotte Amalie High School | School | 1.00 | $52,153,846 | Too close to shore |
| | Edward Wilmoth Blyden Marine Terminal | Port | 1.00 | $15,368,000 | Too close to shore |
| | VI National Guard | Government Building | 1.00 | $10,722,570 | Too close to shore |
| | Airport | Airport | 1.00 | $22,012,987 | Too close to shore |
| Landslide | | | | | |
| | Sea View Nursing Home | Refuge | 0.5 | $ 1,257,125.00 | Moderately Susceptible to Landslide |
| | Bluewater Bible College | Refuge | 0.75 | $ 3,390,000.00 | Large surface area on steep slope |
| | St Thomas Assemblies of God Church | Refuge | 0.75 | $ 894,277.50 | Precode walls |
| Wildfire | | | | $ - | |
| | Bluewater Bible College | Refuge | 0.4 | $10,125,974.00 | Large surface area on steep slope |
| | St Thomas Assemblies of God Church | Refuge | 0.4 | $ 1,017,000.00 | Precode walls |
| | Charlotte Amalie High School | School | 0.6 | $21,564,382.80 | Susceptible to wildfire |
| | Ivanna Eudora Kean | School | 0.6 | $31,292,307.60 | Susceptible to wildfire |
| | Bovoni | | 0.6 | $ - | Susceptible to wildfire (source) |
| | Wapa | Fuel Tank | 0.6 | $ - | Susceptible to wildfire (source) |

## ST. CROIX

| Hazard | Facility Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| Earthquake | Governor's Office | Government Building | 1.00 | $29,976,482 | UNREINFORCED MASONRY |
| | Alexander Henderson Elementary School | School | 1.00 | $15,682,818 | UNREINFORCED MASONRY |
| | Office of the Lt. Governor | Government Building | 1.00 | $15,565,166 | UNREINFORCED MASONRY |
| | Alfredo Andrews Elementary School | School | 1.00 | $15,445,199 | UNREINFORCED MASONRY |
| | Bethlehem Houses | Refuge | 1.00 | $983,454 | UNREINFORCED MASONRY |
| | Property and Procurement | Government Building | 0.99 | $2,331,344 | UNREINFORCED MASONRY |
| | Captain Charles A Seales Fire Station | Fire Station | 0.99 | $1,598,928 | UNREINFORCED MASONRY |
| | Chief Herbert L Canegata Fire Station | Fire Station | 0.99 | $2,425,492 | UNREINFORCED MASONRY |
| | Captain Renceliaz J Cribbs Fire Station | Fire Station | 0.99 | $1,775,081 | UNREINFORCED MASONRY |
| | National Guard Headquarters | Government Building | 0.91 | $8,387,871 | UNREINFORCED MASONRY |
| | Charles Harwood Clinic | Hospitals/Clinic | 0.91 | $45,115,267 | UNREINFORCED MASONRY |
| | Claude O Markae School | School | 0.91 | $12,210,038 | UNREINFORCED MASONRY |
| | Ricardo Richards Elementary School | School | 0.85 | $5,650,428 | UNREINFORCED MASONRY |
| | Juanita Gardin Elementary School | School | 0.83 | $4,217,395 | UNREINFORCED MASONRY |
| | Department of Public Works | Government Building | 0.79 | $3,254,783 | Irregular precode |
| | Water Tanks | Utility | 0.76 | $6,754,600 | Precode |
| | Patrick Sweeney Police Station | Police Station | 0.76 | $7,718,635 | Irregular precode |
| | Water Treatment Plant | Utility | 0.71 | $34,978,919 | Highly Irregular |
| | WAPA Water and Power Plant | Power Stations | 0.71 | $34,978,919 | Highly Irregular |
| | Fire Dept. HQ | Fire Station | 0.65 | $139,902 | Precode |
| | Queen Louise Home for Children | School | 0.63 | $4,474,377 | Precode |
| | Department of Public Works and Human Services | Government Building | 0.62 | $14,024,314 | Precode |

| Hazard | Facility Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| | Wastewater Treatment Plant | Utility | 0.61 | $13,352,279 | Precode |
| | Police Station/DPNR | Police Station | 0.60 | $16,366,176 | Precode |
| **Hurricane** | Property and Procurement | Government Building | 0.84 | $1,982,790 | Precode walls |
| | Alexander Henderson Elementary School | School | 0.81 | $12,646,967 | Precode |
| | Ricardo Richards Elementary School | School | 0.80 | $5,282,843 | Precode |
| | Office of the Lt. Governor | Government Building | 0.77 | $11,942,026 | Precode |
| | Captain Charles A Seales Fire Station | Fire Station | 0.77 | $1,234,788 | Precode |
| | Charles Harwood Clinic | Hospitals/Clinic | 0.76 | $37,396,182 | Precode |
| | Claude O Markae School | School | 0.73 | $9,860,208 | Precode |
| | Red Cross | Refuge | 0.73 | $1,889,251 | Precode |
| | Chief Herbert L Canegata Fire Station | Fire Station | 0.70 | $1,717,859 | Precode |
| | Juanita Gardin Elementary School | School | 0.70 | $3,566,114 | Precode |
| | Governor's Office | Government Building | 0.70 | $20,996,786 | Precode |
| | Captain Renceliaz J Cribbs Fire Station | Fire Station | 0.69 | $1,233,759 | Precode |
| | Alfredo Andrews Elementary School | School | 0.68 | $10,431,597 | Precode |
| | Bethlehem Houses | Refuge | 0.67 | $659,263 | Precode |
| | National Guard Headquarters | Government Building | 0.65 | $5,948,421 | Precode |
| **River Flood Losses** | Governor's Office | Government Building | 0.98 | $29,376,952 | On drainage path |
| | Ricardo Richards Elementary School | School | 0.98 | $6,510,905 | Poor drainage |
| | Lagoon Street Complex | Government Building | 0.65 | $2,312,258 | Poor drainage |
| | Ann Schrader Comand Police Station | Police Station | 0.65 | $676,193 | Poor drainage |
| **Coastal Flood Losses** | Lagoon Street Complex | Government Building | 0.90 | $3,186,392 | Poor Drainage |
| **Tsunami** | Henry E Pochlsen Airport | Airport | 1.00 | $56,500,000 | Too close to shore |
| | Ingerborg Nesbitt Clinic | Hospitals/Clinic | 1.00 | $23,002,838 | Too close to shore |
| | Wastewater Treatment Plant | Utility | 1.00 | $22,600,000 | Too close to shore |
| | Ann E Abramson Pier | Dock | 1.00 | $3,955,000 | Too close to shore |
| | Lagoon Street Complex | Government Building | 1.00 | $3,661,200 | Too close to shore |

| Hazard | Facility Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| | Crallows Bay Warf | Dock | 1.00 | $2,260,000 | Too close to shore |
| | Gordon A Finch Molasses Pier | Dock | 1.00 | $1,695,000 | Too close to shore |
| | Frederiksted Fisherman's Pier | Dock | 1.00 | $113,000 | Too close to shore |
| | Sewage Pumps | Utility | 0.57 | $14,308,442 | Too close to shore |
| | Water Pumps | Utility | 0.38 | $56,959 | Too close to shore |
| | Water Tanks | Utility | 0.17 | $1,526,961 | Too close to shore |
| | Queen Louise Home for Children | School | 1.00 | $7,290,701 | Too close to shore |
| | Herbert Griggs Home for the Aged | Refuge | 1.00 | $8,910,857 | Too close to shore |
| | WAPA Water and Power Plant | Power Stations | 1.00 | $50,850,000 | Too close to shore |
| | WAPA | Government Building | 1.00 | $3,260,564 | Too close to shore |
| | Governor's Office | Government Building | 1.00 | $30,998,982 | Too close to shore |
| | Office of the Lt. Governor | Government Building | 1.00 | $16,096,095 | Too close to shore |
| | Property and Procurement | Government Building | 1.00 | $2,430,234 | Too close to shore |
| | National Guard Headquarters | Government Building | 1.00 | $9,504,914 | Too close to shore |
| | Emile Henderson Fire Station | Fire Station | 1.00 | $2,810,875 | Too close to shore |
| | Chief Herbert L Canegata Fire Station | Fire Station | 1.00 | $2,528,375 | Too close to shore |
| | Captain Charles A Seales Fire Station | Fire Station | 1.00 | $1,666,750 | Too close to shore |
| | Captain Renceliaz J Cribbs Fire Station | Fire Station | 1.00 | $1,850,375 | Too close to shore |
| | Container Port | Dock | 1.00 | $1,695,000 | Too close to shore |
| **Wildfire** | | | | | |
| | Patrick Sweeny Police Station | | 0.6 | $ 6,318,607.80 | In a susceptible area |
| | Anna's Hope Detention Center | Government | 0.5 | $ 9,164,300.00 | In a susceptible area |
| | Captain Renceliar Cribbs Fire Station | Fire | 0.4 | $ 740,150.00 | In a susceptible area |
| | Charles Harword Clinic | Hospital | 0.6 | $30,729,078.60 | In a susceptible area |

| Hazard | Facility Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| | Juan Luis Hospital | Hospital | 0.4 | $23,590,144.00 | In a susceptible area |
| | Herbert Griggs Home for Aging | Refuge | 0.6 | $ 5,346,514.20 | In a susceptible area |
| | Bethlehem House | Refuge | 0.4 | $ 406,800.00 | In a susceptible area |
| | Red Cross | Shelter | 0.4 | $ 1,069,302.80 | In a susceptible area |
| | Ricardo Richards School | School | 0.4 | $ 2,748,160.00 | In a susceptible area |
| | Alfredo Andrews School | School | 0.4 | $ 6,388,814.40 | In a susceptible area |
| | Charles Emmanuel School | School | 0.5 | $ 9,583,222.00 | In a susceptible area |
| | Alexander Henderson | School | 0.5 | $ 4,587,800.00 | In a susceptible area |
| | Queen Louise Home | Refuge/Special needs | 0.5 | $ 31,640.00 | In a susceptible area |
| | OMB | Government | 0.4 | $ 6,487,104.00 | In a susceptible area |
| | DPW | Government | 0.4 | $ 2,105,958.40 | In a susceptible area |

## ST. JOHN

| Hazard | Facility Name | Facility Type | Damage Ratio | Loss to Structure | Prominent Vulnerability |
|---|---|---|---|---|---|
| **Earthquake** | Emmaus Roman Catholic Church | Refuge | 1.00 | $8,991,582 | UNREINFORCED MASONRY |
| | Morris F de Castro Clinic | Hospital/Clinic | 1.00 | $1,965,376 | UNREINFORCED MASONRY |
| | Zulu Company Fire Station | Fire Station | 1.00 | $936,623 | UNREINFORCED MASONRY |
| | Department of Human Services | Government Building | 0.99 | $2,081,316 | UNREINFORCED MASONRY |
| | Guy Benjamin Elentary School | School | 0.99 | $16,234,265 | UNREINFORCED MASONRY |
| | Julius Sprague Elementary School | School | 0.91 | $9,701,993 | UNREINFORCED MASONRY |
| | Administrator's Offices | Government Building | 0.90 | $2,036,915 | Irregular precode |
| | Potable Water Tank | Utility | 0.79 | $52,447 | On steep slope |
| | WAPA Administration/Power Plant | Power Station | 0.76 | $11,263,992 | Precode |
| | PD Motor Vehicles Inspection Station | Police Station | 0.74 | $610,979 | Precode |
| | WAPA Water Tank | Utility | 0.70 | $819,376 | Precode |
| | Bethany Moravian Church | Refuge | 0.67 | $6,884,427 | Irregular precode |
| | Sewage Treatment Plant | Utility | 0.61 | $16,597,797 | Irregular |
| | Seventh Day Adventist Church | Refuge | 0.59 | $1,986,158 | On steep slope |
| **Hurricane** | Morris F de Castro Clinic | Hospital/Clinic | 0.82 | $1,608,693 | Precode |
| | Zulu Company Fire Station | Fire Station | 0.79 | $741,153 | Precode |
| | Julius Sprague Elementary School | School | 0.73 | $7,770,070 | Lots of debris |
| | Guy Benjamin Elentary School | School | 0.72 | $11,794,841 | Precode |
| | PD Motor Vehicles Inspection Station | Police Station | 0.72 | $596,988 | Precode |
| | Emmaus Roman Catholic Church | Refuge | 0.71 | $6,407,265 | Precode walls |

| | | | | | |
|---|---|---|---|---|---|
| | Department of Human Services | Government Building | 0.68 | $1,417,001 | Large roof spans |
| **River Flood** | Emmaus Roman Catholic Church | Refuge | 0.98 | 8,811,750.53 | Precode walls |
| | Julius Sprague Elementary School | School | 0.98 | 10,454,388.11 | Poor drainage |
| | National Park Service/ARC | Government Building | 0.65 | 5,285,162.08 | Poor drainage |
| | Sewage Treatment Plant | Utility | 0.65 | 17,756,813.75 | Poor drainage |
| | Police Department | Police Station | 0.60 | 1,958,713.15 | Poor drainage |
| **Coastal Flood** | National Park Service/ARC | Government Building | 0.90 | $7,283,182 | Too close to shore |
| | WAPA Water Tank | Utility | 0.88 | $1,035,756 | Precode |
| | Sewage Treatment Plant | Utility | 0.85 | $23,220,449 | Low mean elevation |
| | WAPA Administration/Power Plant | Power Station | 0.80 | $11,801,452 | Low mean elevation |
| **Tsunami 2014** | WAPA Administration/Power Plant | Power Station | 1.00 | $15,255,000 | Too close to shore |
| | Julius Sprague Elementary School | School | 1.00 | $11,031,620 | Too close to shore |
| | National Park Service/ARC | Government Building | 1.00 | $8,368,457 | Too close to shore |
| | WAPA Desalinization Plant | Utility | 1.00 | $3,293,143 | Too close to shore |
| | Administrator's Offices | Government Building | 1.00 | $2,350,764 | Too close to shore |
| | Department of Human Services | Government Building | 1.00 | $2,169,600 | Too close to shore |
| | WAPA Water Tank | Utility | 1.00 | $1,217,143 | Too close to shore |
| | Zulu Company Fire Station | Fire Station | 1.00 | $968,571 | Too close to shore |
| | PD Motor Vehicles Inspection Station | Police Station | 1.00 | $856,540 | Too close to shore |
| | Port | Pier | 1.00 | $2,825,000 | Too close to shore |
| | Sewage Treatment Plant | Utility | 1.00 | $28,250,000 | Too close to shore |
| | Emmaus Roman Catholic Church | Refuge | 1.00 | $9,298,286 | Too close to shore |

| | | | | | |
|---|---|---|---|---|---|
| | Police Department | Police Station | 1.00 | $3,375,875 | Too close to shore |
| | VITEMA/DPW | Emergency Response | 1.00 | $5,036,571 | Too close to shore |
| **Wildfire** | Police Inspection | | 0.6 | $519324 | In a susceptible area |
| | Seventh day Adventist Church | Refuge | 0.6 | $2092114 | In a susceptible area |
| | Depart of Human Services | Government | 0.6 | $1301760 | In a susceptible area |
| | WAPA Administration | Government | 0.6 | $9153000 | In a susceptible area |

# APPENDIX F OPTIONS FOR MITIGATION ACTIONS

A range of mitigation actions were presented to the Island Hazard Mitigation Committees for consideration in implementing the goals and objectives. The actions may be added or subtracted as this Plan evolves, taking into account the effectiveness of chosen actions, their completion, or in response to the changing vulnerabilities found in the USVI.

## PROGRAMMATIC ACTIONS

### Prevention

Preventative activities are intended to keep hazard-related problems from getting worse. They are particularly effective in reducing a community's vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Many of the programmatic mitigation actions proposed for implementation at the Territorial level are preventative activities. Examples of preventative activities include:

- Planning and zoning
- Open space preservation
- Stormwater management
- Drainage system maintenance
- Capital improvements programming
- Coastal and riverine setbacks

### Public Information and Awareness

Public information and awareness activities are used to advise residents, business owners, potential property buyers and visitors about hazards, hazardous areas and mitigation actions they can use to protect themselves and their property. Examples of measures to educate and inform the public include:

- Outreach
- Speaker series/demonstration events
- Hazard map information
- Real estate disclosure
- Education
- Training

## PROJECTS

### Emergency Services

Although not typically considered a "mitigation action," emergency services minimize the impact of a hazard event on people and property. These actions are typically taken immediately prior to, during, or in response to a hazard event. Examples include:

- Search and rescue
- Evacuation planning and management
- Flood "fighting" methods (i.e., sandbagging, use of temporary flood walls, etc.)
- Warning systems

- Emergency Operation Center (EOC)
- Retrofitting critical facilities to better withstand disaster events

Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of environmental systems such as floodplains and wetlands. In many cases, environmentally sensitive areas are also high hazard areas. Thus, natural resource protection can serve the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or enhancing recreational opportunities. Parks, recreation or conservation agencies and organizations often implement these measures. Examples include:

- Floodplain protection
- Riparian buffers (establishing no disturbance, no development zoning setbacks along streams, rivers or coastline)
- Fire resistant landscaping
- Erosion and sediment controls
- Wetland preservation and restoration
- Habitat preservation and restoration
- Slope stabilization

Property Protection

Property protection "hardens" existing structures to better withstand hazard events, remove them from hazard prone areas, or provide insurance to cover potential losses. A number of the Island specific mitigation actions proposed in the Plan are considered property protection, especially critical facilities retrofit projects. Examples include:

- Acquisition
- Relocation
- Building Elevation
- Critical facilities protection or "hardening"
- Insurance
- Retrofitting (i.e., windproofing, floodproffing, seismic retrofits)

Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by physically modifying the environment. They are usually designed by engineers and managed or maintained by public works staff. Many of the Island specific mitigation actions proposed in the Plan are structural projects. Examples include:

- Flood control reservoirs
- Levees/dikes/floodwalls
- Storm water management ponds
- Channel modification
- Storm drains and culverts

# APPENDIX G TERRITORIAL AND ISLAND SPECIFIC MITIGATION ACTION PLAN

Appendix I of the Plan Update presents the programmatic and island-specific actions in a matrix format that depicts the prioritization and strategic planning conducted necessary to lead to effective implementation.

The evaluation technique use a weighted **STAPLEE** scoring formula described below:

**S**ocial; the mitigation strategy must be socially acceptable.

- **S** high (3); moderate (2); low (1); and neutral or unknown (0)

**T**echnical; the proposed action must be technically feasible.

- **T** feasible (1); not applicable or unknown (0)

**A**dministrative; the community must have the capability to implement the action (for example, the logical lead agency must be capable of carrying out oversight of the project).

- **A** existing capability (3); training needed (2); staff needed (1); NA

**P**olitical; mitigation actions must be politically acceptable.

- **P** high (3); moderate (2); low (1); NA or neutral (0)

**L**egal; the community must currently have the authority to implement the proposed measure.

- **L** yes (1); no (0)

**E**conomic; economic considerations must include the present economic base, projected growth and opportunity costs.

- **E** weighted at high (6); moderate (4); low (2); neutral or unknown (0)

**E**nvironmental; the impact on the environment must be considered because of statutory considerations and the public's desire for sustainable and environmentally healthy communities.

- **E** high adverse (-3); moderate (-2); minor (-1); NA or unknown (0); and beneficial (2)

# APPENDIX G TERRITORIAL AND ISLAND SPECIFIC MITIGATION ACTION PLAN

A separate matrix is provided for each programmatic or island-specific action that includes the following information:

- Description of the mitigation action,
- Potential for Loss Reduction Rating,
- Priority ranking,
- The goal and objective that the action is intended to achieve,
- The specific hazard the action is intended to achieve (or all hazard),
- Responsible agency, department or division,
- Projected timeframe, Short Term (1-2 years), Medium Term (3-5 years), and Long Term (6-10 years)
- Projected resources,
- Comments on rationale for action, contribution to goal, or other comment, and
- STAPLEE criteria evaluation, by individual criterion and total score.

## TERRITORIAL MITIGATION ACTION PLAN: PROGRAMMATIC ACTIONS

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| USVI-1 | VITEMA collaborates with DPW to prioritize annual budget and action plans to remove built up sediment, debris and maintain natural guts, roadside ditches, drainage channels and storm drains in areas that are designated in this Plan as **Repetitive Loss Strategy (RLS)** designated areas. | Goal 1, Objective 1.1 | H | 1 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Annual activity | | | | | | |
| Comments | VITEMA meets annually with DPW to assist in prioritizing work activities to maintain natural guts | | | | | | |
| Projected resources | USVI line item | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 2 | 1 | 4 | 2 | 16 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| USVI-2 | Seek FMA funding for a planning study to map of **severe repetitive loss and repetitive loss properties**, conduct limited fieldwork, and evaluate hazard mitigation measures that would cost-effectively address clustered repetitive loss properties. | Goal 1, Objective 1.1 | H | 2 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This planning and evaluation study involves mapping repetitive losses, determining clusters of repetitive losses and evaluating a range of alternatives to reduce the number of repetitive losses on all three islands. | | | | | | |
| Projected resources | FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 4 | 0 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| USVI -3 | Strengthen partnerships with the Office of the Governor and media to disseminate information to the general public on hazard mitigation programs and importance of reducing number of **USVI repetitive loss properties.** | Goal 1, Objective1.2 | M | 9 |
| Hazard | All Hazards | | | |
| Lead Agency | VITEMA | | | |
| Projected Timeframe | Short Term | | | |
| Comments | This action seeks to develop an outreach program to provide the community hazard mitigation educational materials, including those on the NFIP, Community Rating System, as well as repetitive loss properties. These outreach activities will educate citizens on the impact of repetitive loss properties in their communities and flood insurance premiums. | | | |
| Projected resources | USVI Operating Budget, PDM | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 1 | 2 | 1 | 2 | 2 | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| USVI-4 | Conduct **watershed planning study** based on a hydrological and hydraulic (H&H) model that would provide the quantitative basis for assessing flood mitigation measures on basin and sub-basin level. The H&H modeling can be used to determine best management solutions for **RLS designated areas** and to build resilience in communities and reduce economic losses. This phased project would begin with St. Croix. | Goal 1, Objective 1.1 | H | 3 |
| Hazard | Flood | | | |
| Lead Agency | VITEMA | | | |
| Projected Timeframe | Three year phased project; one year for each island | | | |
| Comments | Having a flexible hydrologic model and using a standardized set of basins and sub-basins will provide a consistent baseline of hydrology for all three islands and can then be used to evaluate mitigation actions and future development proposals in a systematic and uniform fashion over time. | | | |
| Projected resources | FMA | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 2 | 2 | 1 | 4 | 0 | 12 |

| Action | Description | | | | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|---|---|---|
| USVI-5 | VITEMA will establish relationships in the steady-state (pre-disaster) timeframe with **US HUD and US DOC** and other representatives of primary Federal agency partners of **NDRF Recovery Support Functions** that could facilitate recovery with technical assistance and potential funding in future post-disaster conditions. | | | | Goal 4, Objective 4.2 | L | 4 |
| Hazard | All Hazards | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | The implementation of the National Disaster Recovery Plan (NDRP) establishes clear roles for primary and support Federal agencies in disaster recovery. US HUD and US DOC will play a greater role in short and long-term recovery in future Presidentially-declared disasters. VITEMA should establish roles with key agency representations during the steady-state time, in order to reach out more effectively to those agencies in post-disaster scenarios. | | | | | | |
| Projected resources | USWI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 6 | 0 | 17 |

| Action | Description | | | | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|---|---|---|
| US Virgin Islands-6 | Construct a database management program and develop procedures to collect information on and to track **repetitive loss** properties in the Territory. | | | | Goal 4, Objective 4.1 | H | 5 |
| Hazard | Flood | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Short Term (one year) to develop database then annual updates going forward | | | | | | |
| Comments | This action seeks to gather important information for the implementation of island specific actions focused on minimizing losses in high priority repetitive loss properties. This action will help with the implementation of the specific projects but will also facilitate more accurate reporting on the total number of repetitive loss properties targeted or retrofitted by the Territory. | | | | | | |
| Projected resources | USVI Operating Budget, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 1 | 1 | 2 | 2 | 10 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| US Virgin Islands-7 | Define and implement arrangements for the collection of data on **Landslides, Wildfire, and Drought** that can affect the Territory, including information on location (maps), history, and probability of hazard events. | Goal 4, Objective 4.1 | M | 6 | | | |
| Hazard | All Hazards | | | | | | |
| Lead Agency | DPW, VITEMA | | | | | | |
| Projected Timeframe | Medium Term for defining tracking methodology and researching past events, then annual updates going forward | | | | | | |
| Comments | The collection of hazard data, especially data related to hazard identified in the Plan, is vital on developing more accurate vulnerability and risk assessments, especially when considering climate change variability. This 2014 mitigation action combines several actions first introduced in the 2011 Plan Update. | | | | | | |
| Projected resources | USVI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| USVI-8 | Construct a **database management program** and develop procedures to track mitigation project progress and effectiveness from project award to project completion so as to provide a record on the aggregate actual costs avoided of implemented mitigation projects in the territory. | Goal 4, Objective 4.3 | M | 10 | | | |
| Hazard | All Hazards | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Medium Term to develop database and then annual updates going forward | | | | | | |
| Comments | This action will help VITEMA to track mitigation projects over time and assist in demonstrating improvement in management of FMEA grants | | | | | | |
| Projected resources | USVI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 2 | 2 | 1 | 4 | 0 | 12 |

| Action | Description | | | Goal/Objective | Potential for Loss Reduction | | Priority |
|---|---|---|---|---|---|---|---|
| USVI-9 | Update the multi-hazard risk assessment to incorporate **climate change models** into the hazard and vulnerability analysis. | | | Goal 3, Objective 3.1 | L | | 8 |
| Hazard | Landslide, flood, coastal flooding, drought, wildfire, hurricane | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This project will utilize regional climate change models in refining the hazard identification and risk assessment, so that climate change variability can be better incorporated into the next update of the hazard mitigation strategy. | | | | | | |
| Projected resources | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 2 | 3 | 1 | 4 | 2 | 16 |

| Action | Description | | | Goal/Objective | Potential for Loss Reduction | | Priority |
|---|---|---|---|---|---|---|---|
| USVI-10 | Develop or update Territorial **Debris Management Plan,** including identification of potential satellite locations for collecting and segregating building and woody debris, white goods, and hazardous materials. | | | Goal 4, Objective 4.1 | L | | 7 |
| Hazard | All Hazards | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | | | | | | | |
| Projected resources | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 2 | 1 | 2 | 2 | 14 |

## ST. THOMAS PRIORITIZED MITIGATION ACTIONS

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-1 | Construct drainage improvements on Turpentine Run (Brookman Road) to alleviate localized flooding. | Goal 3, Objective 3.2 | H | 5 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | Committee ranked this stormwater improvement project as being very important for STT | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 1 | 6 | -1 | 14 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-2 | Construct drainage improvements to improve the capacity of the drainage system by Yvonne Bowsky Elementary School (Peace Corp) to alleviate localized flooding. | Goal 3, Objective 3.2 | H | 6 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 1 | 4 | -1 | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-3 | Construct drainage improvements to improve the capacity, and clean, the storm water drainage system in Frydenhoj (next to and across from ball field) to alleviate localized flooding and damage of private property. | Goal 3, Objective 3.2 | H | 7 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Resolving this localized flooding problem would minimize future flood damages to private property | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 1 | 4 | -1 | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-4 | Construct drainage improvements on Rt. 30 adjacent to Bolongo Bay. | Goal 1, Objective 1.1 | H | 9 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Reduce repetitive flooding on this main roadway by the implementation of appropriate drainage infrastructure | | | | | | |
| Projected resource | HMGP, PDM, FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-5 | Construct drainage improvements for major drainage channel that conveys flood waters from the surrounding Altona and Anna's Fancy areas to resolve recurrent flooding after heavy rainfall events. | Goal 3, Objective 3.2 | H | 12 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This improvement would eliminate localized flooding | | | | | | |
| Projected Resource | PDM, HMGP, FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 1 | 4 | -1 | 12 |

| Action | Description | Goal/ Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-6 | Construct Lindberg Estates, Phase IV Drainage Project north through Kirwin Terrace Public Housing Units. | Goal 1, Objective 1.1 | H | 16 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | The construction of this system would provide controlled water runoff through this residential area and reduce localized flooding | | | | | | |
| Projected Resource | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 2 | 1 | 6 | 2 | 16 |

| Action | Description | | Goal/ Objective | | Potential for Loss Reduction | Priority | |
|---|---|---|---|---|---|---|---|
| STT-7 | Improve drainage infrastructure along Rt. 30 Estate Hope / Fortuna to eliminate flooding of nearby residences in Fortuna 3C Subdivision. | | Goal 1, Objective 1.1 | | H | 19 | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | The construction of effective drainage would reduce local flooding and consequent property damage | | | | | | |
| Projected Resource | PDM, HMGP, FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 2 | 1 | 6 | 0 | 14 |

| Action | Description | | | Goal/Objective | | Potential for Loss Reduction | Priority |
|---|---|---|---|---|---|---|---|
| STT-8 | Expand and reinforce communication infrastructure that is being implemented by BIT to mitigate damages from hurricanes to ensure rapid recovery and return to normal service. | | | Goal 3, Objective 3.1 | | H | 13 |
| Hazard | All Hazards, but primarily hurricane-strength winds | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This action would require VITEMA to encourage BIT to undertake hazard mitigation measures that would benefit all residents of the islands. | | | | | | |
| Projected resources | USVI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 2 | 1 | 2 | 0 | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-9 | Replace and improve drainage infrastructure at Food Center in order to resolve flooding of roads, businesses, while addressing potential secondary impacts to wetlands. | Goal 3, Objective 3.2 | H | 14 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Reduce or eliminate repetitive flood damage to infrastructure and commercial property. Surface runoff also affects nearby sensitive wetlands | | | | | | |
| Projected Resource | PDM, HMGP, USVI line item | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-10 | Conduct hydrologic study of the Smith Bay basin and implement drainage improvements to resolve the flooding problems at Coki Point and Smith Bay Roads, and, improvements to open channels draining through the resort complex into Water Bay to resolve localized flooding problems that periodically close roads, create traffic hazards, prevent emergency vehicle and public access, and cause damage to adjacent businesses and road pavement. | Goal 3, Objective 3.2 | H | 3 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Flooding along key roads in the Smith Bay basin impede emergency and residential traffic. A hydraulic analysis in the basin is needed to determine the best approaches to resolve this problem. A long-term solution to this problem would also have significant benefits to coastal and off-shore marine resources in Smith Bay. | | | | | | |
| Projected resources | FMA, PDM, and HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 2 | 2 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-11 | Construct drainage improvements to secondary road that provides access to Caret Bay West. Improvements could include paving and/or providing proper roadside drainage and properly-sized culverts. | Goal 3, Objective 3.2 | H | 18 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Roadway improvements including effective drainage would minimize local flooding and prevent soil erosion | | | | | | |
| Projected Resource | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 6 | 2 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-12 | Complete Installation of Hurricane Shutters at main police station in Charlotte Amalie. | Goal 3, Objective 3.2 | L | 20 | | | |
| Hazard | Hurricane | | | | | | |
| Lead Agency | DPW, OMB | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | This action would reduce the possibility of Hurricane damage to this critical installation | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 1 | 4 | 0 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-13 | Improve drainage infrastructure along Hospital Gade from Antonio Jarvis School to the Police Station on Verteran's Drive, paying particular attention to the intersection of Hospital and Kongens Gade (Moravian Church and Zoras). | Goal 3, Objective 3.2 | M | 21 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | The construction of effective drainage would reduce local flooding and consequent property damage including critical facilities. | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| | | | | | | | |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-14 | Replace and improve drainage infrastructure along Rt. 33 (Estate Dorothea) | Goal 3, Objective 3.2 | M | 22 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Reduce possible localized flooding and roadway damage as well as soil erosion | | | | | | |
| Projected Resource | DPW Operating Budget, PDM, and HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 2 | 1 | 4 | 2 | 14 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-15 | Resolve flooding problems at Subbase Entrance. Pursue Phase II drainage improvements which include the installation of properly-sized culverts from Bellows across Veterans Drive to connect to Phase I drainage improvements. | Goal 3, Objective 3.2 | H | 8 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Minimize local flooding to commercial property. Preliminary designs have already been completed for this project. | | | | | | |
| Projected resources | HMGP, PDM, and FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 1 | 4 | 0 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-16 | Enlarge box culverts, storm drains, and improvements to open channels from Veterans Drive to the Bay along the east edge of Frenchtown in southwest Charlotte Amalie, in order to resolve flooding, traffic access and business interruption. | Goal 3, Objective 3.2 | H | 10 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium term | | | | | | |
| Comments | Flooding affects a major thoroughfare and access to an economically important community and also impacts local businesses | | | | | | |
| Projected Resource | HMGP, PDMC, and FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 0 | 4 | -2 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-17 | Harden WAPA Substations. Design and construction of hardened switchgear buildings at the East End and Tutu Substations. | Goal 3, Objective 3.2 | M | 25 | | | |
| Hazard | All Hazards | | | | | | |
| Lead Agency | WAPA | | | | | | |
| Projected Timeframe | 5 Years | | | | | | |
| Comments | This action would reduce the disruption of electrical energy to the growing business community and populous of the east end of St. Thomas and St. John | | | | | | |
| Projected Resource | PDMC, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 3 | 1 | 4 | 0 | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-18 | Water Island Ferry Dock at "Philips Landing" experiences periodic flooding in the main turn around area. Periodic flooding caused by inadequate drainage at this facility impedes ferry traffic and emergency vehicles | Goal 3, Objective 3.2 | M | 8 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Critical Facility | | | | | | |
| Projected resources | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 2 | 0 | 13 |

| Action | Description | | | Goal/Objective | | Potential for Loss Reduction | Priority |
|---|---|---|---|---|---|---|---|
| STT-19 | Honeymoon Beach at Druif Bay, western end of Water Island; flooding caused from inadequate drainage blocks vehicular passage and covers road with as much as 3 feet on the beach road and then takes as much as 3 weeks to drain. Economic impacts by blocking access to two commercial establishments and public health issue from mosquito breeding. | | | Goal 1, Objective 1.1 | | H | 10 |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Public health issue and no action would adversely affect tourism and local businesses | | | | | | |
| Projected resources | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| | | | | | | | |

| Action | Description | | | Goal/Objective | | Potential for Loss Reduction | Priority |
|---|---|---|---|---|---|---|---|
| STT-20 | Pearl and Larsen School structural retrofit of roof | | | Goal 1, Objective 1.1 | | H | 2 |
| Hazard | Hurricane | | | | | | |
| Lead Agency | Department of Education | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | | | | | | | |
| Projected resources | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 2 | 0 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-21 | Evelyn Williams School hurricane-strength wind mitigation retrofit of structural roof system and roof replacement. | Goal 1, Objective 1.1 | H | 6 | | | |
| Hazard | Hurricane | | | | | | |
| Lead Agency | Department of Education | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | | | | | | | |
| Projected resources | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 4 | 0 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-22 | Resolve flooding problems at Abattoir Estate Nadir (race track) due to inadequate drainage. | Goal 1, Objective 1.1 | M | 23 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium | | | | | | |
| Comments | | | | | | | |
| Projected resources | PDM, HMGP, DPW Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 4 | 0 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STT-23 | Address inadequate drainage at Tutu Fire Station | Goal 1, Objective 1.1 | M | 12 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | This mitigation action could be resolved by straight forward drainage improvements at this critical facility | | | | | | |
| Projected resources | DPW Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 2 | -1 | 12 |

| Action | Description | | | Goal/Objective | Potential for Loss Reduction | | Priority |
|---|---|---|---|---|---|---|---|
| STT-24 | Structural retrofit of following critical facilities used for sheltering (Lockhart School, Bertha Bochulte Middle School, and, Human Services Head Start building). | | | Goal 3, Objective 3.2 | H | | 4 |
| Hazard | Hurricane | | | | | | |
| Lead Agency | Department of Education | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Critical facility used for sheltering | | | | | | |
| Projected resources | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 6 | 0 | 17 |

| Action | Description | | | Goal/Objective | Potential for Loss Reduction | | Priority |
|---|---|---|---|---|---|---|---|
| STT-25 | Retrofit of electrical system at Blue Water Bible College to enable back-up power for all 3 main buildings from existing generator. | | | Goal 1, Objective 1.1 | L | | 11 |
| Hazard | All Hazards, but primarily hurricane-strength winds | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Not a generator mitigation action, in that the generator is already in place, only needs modification to the electrical system to provide emergency power to all 3 main buildings at this educational non-profit facility. | | | | | | |
| Projected resources | HMGP, Public Assistance Section 406 | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 3 | 1 | 1 | 2 | 0 | 10 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STT-26 | Four power line projects to place feeder lines underground to eliminate damage from hurricane strength winds. They include feeder lines: 9A; 8E; 13; and, 7E) | Goal 3, Objective 3.2 | H | 9 |
| Hazard | Hurricane | | | |
| Lead Agency | WAPA | | | |
| Projected Timeframe | Mid-Term | | | |
| Comments | | | | |
| Projected resources | HMGP, PDM | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 2 | 3 | 1 | 2 | -1 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STT-27 | Rehabilitation of Water Storage Tank at Sara Hill to include seismic and wind retrofit. Complete rehabilitation and upgrade of the 105 MG Water Storage Tank. Work includes structural repairs and new wind girders and seismic joints. | Goal 3, Objective 3.2 | H | 7 |
| Hazard | Hurricane and Earthquake | | | |
| Lead Agency | WAPA | | | |
| Projected Timeframe | Mid-Term | | | |
| Comments | | | | |
| Projected resources | HMGP, PDM | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 2 | 3 | 1 | 2 | 0 | 12 |

## ST. CROIX PRIORITIZED MITIGATION ACTIONS

| Action | Description | | Goal/Objective | Potential for Loss Reduction | | Priority | |
|---|---|---|---|---|---|---|---|
| STX-1 | Resolve flooding problems and improve storm water drainage infrastructure in the "Grove at La Reine". | | Goal 1, Objective 1.1 | H | | 24 | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Emphasis on reducing potential flood damages to private properties | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 0 | -1 | 10 |

| Action | Description | | Goal/Objective | Potential for Loss Reduction | | Priority | |
|---|---|---|---|---|---|---|---|
| STX-2 | Conduct a hydrological study of the St. Croix watersheds with particular attention given to the La Grange, Prosperity, Bethlehem and Salt River basins. Up[grade inadequate drainage systems to reduce the impact of flooding (see USVI-4 Mitigation Action). | | Goal 1, Objective 1.1 | M | | 1 | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Phasing required; should prioritize basins based upon flood risk and potential flood damages | | | | | | |
| Projected Resource | HMGP, PDM, USACE | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 4 | 0 | 15 |

| | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STX-3 | Perform assessment of flooding problems within La Grande Princess Estate. Approximately 50 of 225 NFIP-insured losses occur in La Grande Princess. (see USVI-2 Mitigation Action). | Goal 1, Objective 1.1 | H | 2 |
| Hazard | Flood | | | |
| Lead Agency | DPW, DPNR, VITEMA | | | |
| Projected Timeframe | Long Term | | | |
| Comments | This action seeks to reduce severe repetitive property losses. | | | |
| Projected Resource | PDM, HMGP, FMA | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 1 | 3 | 1 | 6 | 2 | 17 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STX-4 | Construct drainage system to along Melvin H. Evans in the area west of Williams Delight Stop Light and Carlton. Extend drainage system to connect with drainage improvements in Williams Delight Community. | Goal 1, Objective 1.1 | H | 10 |
| Hazard | Flood | | | |
| Lead Agency | DPW | | | |
| Projected Timeframe | Medium Term | | | |
| Comments | This action would reduce and eliminate chronic localized flooding along this important roadway | | | |
| Projected Resource | HMGP, PDM | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 1 | 1 | 4 | 2 | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STX-5 | Conduct a hydrological study of the Christiansted watershed or catchment area with particular attention given to the sub-watersheds of Spring Gut and Water Gut to determine technically feasible and cost effective structural solutions to address the flooding problem in Christiansted | Goal 1, Objective 1.1 | M | 12 |
| Hazard | Flood | | | |
| Lead Agency | VITEMA, DPW, DPNR | | | |
| Projected Timeframe | Short Term | | | |
| Comments | This study would determine the viability and cost effectiveness of establishing and executing a plan for the long term reduction of the chronic flooding in Christiansted | | | |
| Projected Resource | PDM, HMGP, and USACE | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 2 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STX-6 | Resolve flooding problems and improve storm water drainage infrastructure for "Spring Gut" all the way to Gallows Bay. | Goal 1, Objective 1.1 | H | 13 |
| Hazard | Flood | | | |
| Lead Agency | DPW | | | |
| Projected Timeframe | Medium Term | | | |
| Comments | The construction of adequate drainage infrastructure would reduce and eliminate localized flooding to commercial and residential properties. | | | |
| Projected Resource | PDM, HMGP | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 1 | 1 | 6 | 2 | 14 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-7 | Resolve flooding problems and improve storm water drainage infrastructure for Tide Village by implementing a low water crossing to divert surface run-off into the natural gut. | Goal 1, Objective 1.1 | H | 14 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | This action seeks to reduce and eliminate localized flooding in Tide Village. The roadway was constructed without adequate drainage. | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-8 | Pursue Christiansted Gut USACE Section 205 Project. Preliminary feasibility phase currently underway by the Corps to determine whether technically feasible and cost effective solutions exist to reduce flood damages in residential and business areas adjacent to King Cross St. | Goal 1, Objective 1.1 | M | 17 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | This study would create a solution for the reduction and elimination of structural and infrastructure loss due to flooding. | | | | | | |
| Projected Resource | PDM, HMGP, and USACE | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 1 | 1 | 4 | 2 | 12 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | |
|---|---|---|---|---|---|---|
| STX-9 | Construct a retention pond at the property line of White Bay, and the National Park Service reserve within the localized depression. | Goal 1, Objective 1.1 | H | 18 | | |
| Hazard | Flood | | | | | |
| Lead Agency | DPW, NPS | | | | | |
| Projected Timeframe | Medium Term | | | | | |
| Comments | The construction of a retention pond would reduce and eliminate localized flooding to residences in White Bay. Environment Assessment may be required by National Park Service. | | | | | |
| Projected Resource | PDM, HMGP, NPS, | | | | | |
| S | T | A | P | L | E | E | Score |
| 2 | 1 | 1 | 2 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-10 | Perform assessment of adjacent drainage basins that flow into Estate Williams Delight to identify alternate routing of surface runoff. Evaluate creation of stormwater detention pond below Blue Mountain. | Goal 1, Objective 1.1 | H | 21 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This assessment and eventual construction of an adequate drainage system would reduce and eliminate localized flooding. | | | | | | |
| Projected Resource | HMGP, PDM | | | | | | |
| S | T | A | P | L | E | E | Score |
| 1 | 1 | 1 | 1 | 1 | 4 | 2 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-11 | Implement and improve storm water drainage infrastructure to relieve flooding at the Alfredo Andrews School and adjacent low-lying areas. | Goal 1, Objective 1.1 | H | 5 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Localized flooding problem | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-12 | Construct drainage improvements at the Ricardo Richards Elementary School at Estate Barren Spot near Melvin H. Evans Highway (Route 66). | Goal 3, Objective 3.1 | H | 19 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Short term | | | | | | |
| Comments | This action would reduce and eliminate localized flooding and at this critical facility and related property loss | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 4 | 0 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-13 | Improve Recovery Hill Water Storage Tanks. Install wind girders to reinforce against hurricane-strength winds. | Goal 3, Objective 3.2 | M | 9 | | | |
| Hazard | Hurricane | | | | | | |
| Lead Agency | WAPA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This action would reduce the loss of vital potable water from a hurricane event | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| S | T | A | P | L | E | E | Score |
| 3 | 1 | 1 | 3 | 1 | 2 | 0 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-14 | Implement and provide emergency power generator units for all wastewater pumping stations on St. Croix. | Goal 3, Objective 3.2 | L | 11 | | | |
| Hazard | All Hazardsw | | | | | | |
| Lead Agency | WAPA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This action would reduce the interruption of wastewater treatment following disaster events | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| S | T | A | P | L | E | E | Score |
| 3 | 1 | 1 | 3 | 1 | 2 | 0 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-15 | Pursue equipment anchoring program for the Richmond Electrical Generating Plant. Anchor critical equipment in the Plant to mitigate damages caused by earthquake, hurricane-strength winds, tsunami and storm surge. | Goal 3, Objective 3.2 | H | 15 | | | |
| Hazard | All Hazards | | | | | | |
| Lead Agency | VIWAPA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | The anchoring of essential equipment would reduce damage to electrical generating systems due to a natural disaster event | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 4 | 0 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-16 | Improve Water Storage Tanks throughout the island. Install flexible connectors at multiple water storage tanks to permit pipe flexibility during earthquake events and ensure rapid recovery and normal service. | Goal 3, Objective 3.2 | M | 16 | | | |
| Hazard | Earthquake | | | | | | |
| Lead Agency | WAPA | | | | | | |
| Projected Timeframe | Long Term | | | | | | |
| Comments | This action would reduce and eliminate the loss of vital potable water in the event of a natural hazard event | | | | | | |
| Projected Resource | PDM, HMGP | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 2 | 1 | 3 | 0 | 10 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-17 | Lew Muckle School shutter project | Goal 1, Objective 1.1 | H | 23 | | | |
| Hazard | Hurricane | | | | | | |
| Lead Agency | Department of Education | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | | | | | | | |
| Projected resources | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 2 | 0 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-18 | The 30" Coastal Interceptor transports sewage from the La Grande Princess area to the LBJ Pump Station in Christiansted. Shoreline erosion from coastal storms has left the interceptor submerged in the sea approximately 50' from the shore. The mitigation action would reroute the pipeline inland, replacing approx. 1900' of pipe, construct new lift station and associated improvements. | Goal 3, Objective 3.2 | H | 4 | | | |
| Hazard | Coastal Flooding and Storm Surge | | | | | | |
| Lead Agency | WMA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This is a very important mitigation action as not taking action could led to failure of the Coastal Interceptor, a critical infrastructure for moving sewage to the waste water treatment plant. It would not only pose a public health and social issues due to the failure of the system but would have significant environmental impacts to marine resources. This issue has been caused by natural hazards operating over a number of years, could lead to failure from a future coastal storm or hurricane, and should receive serious attention by Territorial and Federal funding agencies. It should be addressed as soon as possible, subject to available funding. | | | | | | |
| Projected resources | EPA, HMGP, PDM, HUD, DOC, USDA RDA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 6 | 2 | 19 |

| Action | Description | | | Goal/Objective | | Potential for Loss Reduction | Priority |
|---|---|---|---|---|---|---|---|
| STX-19 | FEMA Community Rating System (CRS). Initiate a planning project to have STX become a CRS Community by developing a strategy and action plan for improving the flood management program on the Island. The planning study would include an outreach strategy and series of community meetings on the NFIP Program, first living floor and base flood elevation determinations, LOMARS, and other flood insurance questions and concerns. | | | Goal 4, Objective 4.1 | | M | 3 |
| Hazard | Flood | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Long Term | | | | | | |
| Comments | FEMA representatives have indicated that St. Croix would be considered as a community within the USVI and therefore could pursue designation as a community participating in the CRS initiative | | | | | | |
| Projected resources | USVI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 2 | 3 | 1 | 2 | 0 | 12 |

| Action | Description | | | Goal/Objective | | Potential for Loss Reduction | Priority |
|---|---|---|---|---|---|---|---|
| STX-20 | LBJ Pump Station flood and storm surge protection. The pump station is located 215' south of an existing gut and 125' from the shoreline. Mitigation action involves improving conveyance from existing gut, regarding and rising existing roadway to site, fabrication of flood prevention brackets to provide protection from floodwaters and storm surge. | | | Goal 3, Objective 3.2 | | H | 7 |
| Hazard | Coastal Flooding and Storm Surge | | | | | | |
| Lead Agency | WMA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Increased probability of damage to this facility by flash flooding from the nearby gut, coastal flooding and storm surge argue that this proposed mitigation action deserves attention. It also has environmental impacts if not addressed. | | | | | | |
| Projected resources | HMGP, FMA, EPA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 2 | 2 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-21 | Structural retrofits of Claude Markoe School and St. Croix Educational Complex critical facilities used for sheltering. | Goal 3, Objective 3.2 | H | 8 | | | |
| Hazard | Hurricane | | | | | | |
| Lead Agency | Department of Education | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Critical facilities used for sheltering should receive high priority for funding | | | | | | |
| Projected resources | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 4 | 0 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-22 | Structural retrofits of Juan Luis Hospital for enhanced protection from hurricane-strength winds and earthquake hazards. | Goal 3, Objective 3.2 | H | 22 | | | |
| Hazard | Hurricane and Earthquake | | | | | | |
| Lead Agency | VITEMA | | | | | | |
| Projected Timeframe | Long Term | | | | | | |
| Comments | Critical Facility | | | | | | |
| Projected resources | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 3 | 1 | 2 | 0 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-23 | Place Queen Street power lines in Christiansted underground to eliminate damage from hurricane-strength winds. | Goal 3, Objective 3.2 | H | 6 | | | |
| Hazard | Hurricane | | | | | | |
| Lead Agency | WAPA | | | | | | |
| Projected Timeframe | Mid-term | | | | | | |
| Comments | | | | | | | |
| Projected Resource | HMGP, PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 0 | -1 | 10 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STX-24 | Storm flows from Tropical Storm Otto collapsed a culvert and road crossing of Gut 5 in Enfield Green that connects the east and west sides of the Estate. Mitigation action involves replacing culvert with a larger diameter and implementing drainage improvements on Gut 5. | Goal 3, Objective 3.2 | M | 20 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Challenge for this action is that it is a private road within a development with a homeowners association without the funds to undertake the necessary work to replace the culvert and stream crossing. | | | | | | |
| Projected resources | HMGP, PDM, FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 3 | 2 | 0 | 0 | 0 | 8 |

## ST. JOHN PRIORITIZED MITIGATION ACTIONS

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STJ-1 | Conduct a hydrological study of Coral Bay watershed to propose technically feasible and cost-effective solutions to flooding problems due to storm drain locations, undersized drainage, and lack of consideration of natural drainage guts. | Goal 1, Objective 1.1 | M | 2 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | VITEMA, DPNR | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Flooding is a persistent problem in Coral Bay. VITEMA should have direct liaison with Coral Bay Community Council to define specifications for such a project | | | | | | |
| Projected Resource | HMGP, PDM, FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 1 | 1 | 1 | 1 | 1 | 4 | 2 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STJ-2 | Evaluate and construct drainage improvements to eliminate localized flooding at the lower end of "Carolina Gut" at Little Plantation. | Goal 1, Objective 1.1 | H | 6 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPNR, DPW | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | The construction of this drainage system would alleviate localized flooding to reduce repetitive losses to residential and commercial properties that resulted from incorrect siting | | | | | | |
| Projected Resource | PDM, FMA, USVI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 1 | 1 | 4 | 2 | 13 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | | |
|---|---|---|---|---|---|---|---|---|
| ST-3 | Construct drainage improvements to eliminate localized flooding at Pond Mouth at intersection of Rt. 102 and Rt. 105. | Goal 1, Objective 1.1 | H | 7 | | | | |
| Hazard | Flood | | | | | | | |
| Lead Agency | DPW | | | | | | | |
| Projected Timeframe | Short Term | | | | | | | |
| Comments | Alleviate localized flooding due to inappropriate infrastructure constructed during port expansion at Pond Mouth exacerbating flooding problems. | | | | | | | |
| Projected Resources | HMGP, PDM, FMA, USVI Operating Budget | | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** | |
| 3 | 1 | 1 | 2 | 1 | 4 | -1 | 11 | |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | | |
|---|---|---|---|---|---|---|---|---|
| STJ-4 | Implementing a slope stabilization program to reduce damage and blockage of roads during wind storm and flooding events. A program establishment of more stable and cut and fill slopes, removal of material that may be subject to landslide and rock fall events, re-vegetation, of disturbed slopes, etc. | Goal 1, Objective 1.1 | H | 8 | | | | |
| Hazard | Flood, Landslide and Hurricane | | | | | | | |
| Lead Agency | DPW | | | | | | | |
| Projected Timeframe | Medium Term | | | | | | | |
| Comments | To minimize the possibility of road closure. The assessment will provide DPW with technically feasible and cost effective options and facilitate emergency access to Coral Bay | | | | | | | |
| Projected Resources | HMGP, PDM, USVI USVI Operating Budget | | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** | |
| 3 | 1 | 1 | 2 | 1 | 4 | 2 | 14 | |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STJ-5 | Evaluate and construct drainage improvements to eliminate localized flooding along Route 20 southbound in Coral Bay (Estate Carolina). | Goal 1, Objective 1.1 | H | 11 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | The construction of this drainage improvement wou9ld reduce localized flooding and damage to residential and commercial property and provide emergency access | | | | | | |
| Projected Resource | HMGP, PDM, FMA , USVI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 1 | 0 | 4 | -1 | 9 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STJ-6 | Increase fuel capacity of the Myra Keating Health Clinic Emergency power generator unit. | Goal 3, Objective 3.1 | H | 5 | | | |
| Hazard | All Hazards | | | | | | |
| Lead Agency | WAPA, DH | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | Ensure a more constant and longer lasting source of power at only health facility on the island | | | | | | |
| Projected Resource | PDM | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 3 | 0 | 4 | 0 | 11 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STJ-7 | Provide an alternate power generation substation for Coral Bay to ensure that there is adequate power source for all public services and critical facilities on the east end of the Island. | Goal 3, Objective 3.2 | H | 4 |
| Hazard | All Hazards | | | |
| Lead Agency | WAPA | | | |
| Projected Timeframe | Medium Term | | | |
| Comments | This action would provide critical emergency power supply to eastern end of island that may be isolated during a hazard event. | | | |
| Projected Resources | HMGP, PDM | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 1 | 2 | 6 | 2 | 15 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority |
|---|---|---|---|---|
| STJ-8 | Construct underground feeders from the St. John substation to various termination points within Cruz Bay to mitigate damages to hurricane winds and ensure rapid recovery and return to normal service. | Goal 3, Objective 3.2 | H | 9 |
| Hazard | Hurricane | | | |
| Lead Agency | WAPA, VITEMA | | | |
| Projected Timeframe | Medium Term | | | |
| Comments | This hardening of the electrical distribution system would provide for the timely restoration of power | | | |
| Projected Resources | HMGP, PDM | | | |

| S | T | A | P | L | E | E | Score |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 2 | 0 | 6 | 2 | 14 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STJ-9 | Improve drainage infrastructure (Box Culverts) at WAPA building and treatment plant, while addressing potential secondary impacts to wetlands. | Goal 3, Objective 3.2 | H | 10 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW, VIWAPA | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This action would reduce potential localized flooding | | | | | | |
| Projected Resources | HMGP, PDM, USVI Operating Budget | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 2 | 1 | 1 | 3 | 1 | 4 | 2 | 14 |

| Action | Description | Goal/Objective | Potential for Loss Reduction | Priority | | | |
|---|---|---|---|---|---|---|---|
| STJ-10 | Coordinate with the National Park Service for the construction of appropriate drainage system improvements to eliminate localized flooding along Route Rt. 20 in Maho Bay. | Goal 3, Objective 3.2 | H | 12 | | | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Medium Term | | | | | | |
| Comments | This action would reduce localized flooding along central Road and assure emergency access | | | | | | |
| Projected Resource | HMGP, PDM, FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 1 | 1 | 1 | 4 | 2 | 13 |

| Action | Description | | | Goal/Objective | Potential for Loss Reduction | Priority | |
|---|---|---|---|---|---|---|---|
| STJ-11 | Resolve flooding concerns from inadequate drainage at Cruz Bay Fire Station. | | | Goal 3, Objective 3.2 | M | 3 | |
| Hazard | Flood | | | | | | |
| Lead Agency | DPW | | | | | | |
| Projected Timeframe | Short Term | | | | | | |
| Comments | For the more frequent storm events, inadequate drainage at the Cruz Bay Fire Station could be addressed by straight forward drainage improvements in the immediate vicinity. | | | | | | |
| Projected resources | USVI Operating Budget, PDM, FMA | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 3 | 1 | 2 | 0 | 13 |

| Action | Description | | | Goal/Objective | Potential for Loss Reduction | Priority | |
|---|---|---|---|---|---|---|---|
| STJ-12 | Functional replacement and relocation of the Fire Station in Coral Bay due to multiple coastal hazards and structural issues of this critical facility resulting from subsidence. | | | Goal 3, Objective 3.2 | H | 1 | |
| Hazard | Coastal Flooding and Storm Surge | | | | | | |
| Lead Agency | Fire Service | | | | | | |
| Projected Timeframe | Long Term | | | | | | |
| Comments | Over the long term there is a clear need to relocate this critical facility away from coastal hazards. | | | | | | |
| Projected resources | HMGP, DHS, other potential Federal funding sources | | | | | | |
| **S** | **T** | **A** | **P** | **L** | **E** | **E** | **Score** |
| 3 | 1 | 3 | 1 | 1 | 2 | 0 | 11 |

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COMMONWEALTH OF PUERTO RICO

# PUERTO RICO HAZARD MITIGATION PLAN

*Revision 2016*


FEMA



Prepared by:
JM Professional Planning Consultants, P.C.

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# LIST OF ACRONYMS

| ACRONYM | ENGLISH | SPANISH |
|---|---|---|
| AAA | Aqueduct and Sewer Authority | Autoridad de Acueductos y Alcantarillados |
| AEE | Electric Power Authority | Autoridad de Energía Eléctrica |
| AEMEAD | State Emergency Management and Disaster Administration Agency | Agencia Estatal para el Manejo de Emergencias y Administración de Desastres |
| AEP | Public Buildings Authority | Autoridad de Edificios Públicos |
| AFI | Infrastructure Financing Authority | Autoridad para el Financiamiento de la Infraestructura |
| AP | Port Authority | Autoridad de Puertos |
| ARPE | Regulations and Permits Administration | Administración de Reglamentos y Permisos |
| BCA | Benefit-Cost Analysis | Análisis de Costo-Beneficio |
| CAO | Caribbean Area Office | Oficina del Área del Caribe |
| CariCOOS | Caribbean Coastal and Observation System | Sistema de Observación Costera del Caribe |
| CCCPR | Puerto Rico Climate Change Council | Consejo del Cambio Climático de Puerto Rico |
| CDBG | Community Development Block Grant | Subvención en Bloque para Desarrollo Comunitario |
| CERT | Community Emergency Response Teams | Programa de Equipos Comunitarios de Respuesta a Emergencias |
| CLCC | Caribbean Landscape Conservation Cooperative | Cooperativa para la Conservación del Paisaje en el Caribe |
| CSC | Climate Science Center | Centro de Ciencia del Clima |
| DMA | Disaster Mitigation Act | Ley de Mitigación de Desastres |
| DRNA | Department of Natural and Environmental Resources | Departamento de Recursos Naturales y Ambientales |
| EAS | Emergency Alert System | Sistema de Alerta de Emergencia |
| ELA | Commonwealth of Puerto Rico | Estado Libre Asociado de Puerto Rico |
| EMI | Emergency Management Institute | Instituto de Manejo de Emergencias |
| EMPG | Emergency Management Performance Grant | Programa de Subvenciones para el Desempeño de Manejo de Emergencias |
| EWP | Emergency Watershed Protection | Programa de Emergencias de Protección de Cuencas |
| FEMA | Federal Emergency Management Agency | Agencia Federal para el Manejo de Emergencias |

| ACRONYM | ENGLISH | SPANISH |
|---|---|---|
| FIRM | Flood Insurance Rate Maps | Mapas sobre  Tasas de Seguro de Inundación |
| FMA | Flood Mitigation Assistance Program | Asistencia de Mitigación Contra Inundaciones |
| GAR | Governor's Authorized Representative | Representante Autorizado del Gobernador |
| GIS | Geographical Information System | Sistema de Información Geográfica |
| HMGP | Hazard Mitigation Grant Program | Programa de Subvención de Mitigación de Riesgos |
| ICBO | International Conference of Building Officials | Conferencia Internacional de Oficiales de Construcción |
| ICC | International Code Council | Consejo Internacional de Códigos |
| IITF | International Institute of Tropical Forest | Instituto Internacional de Bosques Tropicales |
| JCA | Environmental Quality Board | Junta de Calidad Ambiental |
| JP | Puerto Rico Planning Booard | Junta de Planificación de Puerto Rico |
| JR | Review Board | Junta Revisora |
| NCSU | North Carolina State University | Universidad Estatal de Carolina del Norte |
| NCWCG | National Coastal Wetlands Conservation Grant Program | Programa Nacional para la Conservación de Humedales Costeros |
| NDSP | National Dam Safety Program | Programa de Seguridad Nacional de Presas |
| NEON | National Ecological Observatory Network | Red Nacional de Observatorios Ecológicos |
| NFIP | National Flood Insurance Program | Programa Nacional de Seguros contra Inundaciones |
| NOAA | National Oceanography and Atmospheric Administration | Oficina Nacional de Administración Oceánica y Atmosférica |
| NSF | National Science Foundation | Fundación Nacional de las Ciencias |
| OIGPe | Office of the Chief Permit Inspector | Oficina del Inspector General de Permisos |
| OGPe | Permit Management Office | Oficina de Gerencia de Permisos |
| OMB | Office of Management and Budget | Oficina de Gerencia y Presupuesto |
| OMME | Municipal Emergency Management Office | Oficina Municipal de Manejo de Emergencia |
| PDM | Pre-Disaster Mitigation Grant | Programa de Mitigación Pre-Desastre |
| PEMPN | Puerto Rico State Natural Hazards Mitigation Plan | Plan Estatal de Mitigación de Peligros Naturales de Puerto Rico |
| PMZC | Coastal Zone Management Program | Programa de Manejo de la Zona Costera |

| ACRONYM | ENGLISH | SPANISH |
|---|---|---|
| POT | Territorial Ordinance Plan | Plan de Ordenación Territorial |
| PRBC | Puerto Rico Building Code | Código de Construcción de Puerto Rico |
| PUCPR | Pontifical Catholic University of Puerto Rico | Pontificia Universidad Católica de Puerto Rico |
| PUT | Land-Use Plan | Plan de Uso de Terrenos |
| RSPR | Seismic Network of Puerto Rico | Red Sísmica de Puerto Rico |
| SECC | State Emergency Communications Committee | Comité Estatal de Comunicaciones de Emergencia |
| SIP | Integrated Permit System | Sistema Integrado de Permisos |
| SRO-ZMT | Official Maritime Terrestrial Zone Reference System | Sistema de Referencia Oficial para el deslinde de la Zona Marítimo Terrestre |
| STAPLEA | Social, Technical, Administrative, Political, Legal, Economic, and Environmental | Social, Técnico, Administrativo, Político, Legal, Económico, y AMbiental |
| UMET | Metropolitan University of Puerto Rico | Universidad Metropolitana de Puerto Rico |
| UPPR | Polytechnic University of Puerto Rico | Universidad Politécnica de Puerto Rico |
| UPR | University of Puerto Rico | Universidad de Puerto Rico |
| USACE | United States Army Corps of Engineers | Cuerpo de Ingenieros de los Estados Unidos |
| USFWS | United States Fish & Wildlife Service | Servicio de Pesca y Vida Silvestre de Estados Unidos |
| USFS | United States Forest Servicio | Servicio Forestal de los Estados Unidos |
| USGS | United States Geological Survey | Servicio Geológico de los Estados Unidos |

# EXECUTIVE ORDER

ESTADO LIBRE ASOCIADO DE PUERTO RICO
LA FORTALEZA
SAN JUAN, PUERTO RICO

**Boletín Administrativo Núm. OE-2016-021**

**ORDEN EJECUTIVA DEL GOBERNADOR DEL ESTADO LIBRE ASOCIADO DE PUERTO RICO, HON. ALEJANDRO J. GARCÍA PADILLA, PARA ADOPTAR EL PLAN ESTATAL DE MITIGACIÓN DE PELIGROS NATURALES DE PUERTO RICO, ORDENAR SU IMPLEMENTACIÓN Y DEROGAR EL BOLETÍN ADMINISTRATIVO NÚM. OE-2011-039.**

**POR CUANTO:** La Ley 211-1999, según enmendada, conocida como la "Ley de la Agencia Estatal para el Manejo de Emergencias y Administración de Desastres de Puerto Rico" (en adelante, "Ley 211-1999"), estableció la política pública del Gobierno de Puerto Rico para proteger a los habitantes en situaciones de emergencia o desastre que afecten al país, y proveer asistencia necesaria y efectiva para la protección antes, durante y después de estos eventos.

**POR CUANTO:** De igual forma, la Ley 211-1999 creó la Agencia Estatal para el Manejo de Emergencias y Administración de Desastres (en adelante, "AEMEAD") para ejecutar esta política pública, con la facultad y responsabilidad de coordinar todos los planes estatales, municipales, privados y federales pertinentes. Asimismo, la referida legislación establece que el Director de la AEMEAD ejercerá como Oficial Estatal de Mitigación del Gobierno de Puerto Rico, y ordena la creación del Comité Interagencial para la Mitigación de Riesgos Naturales y Tecnológicos, con la responsabilidad de preparar e implementar el plan de mitigación estatal.

**POR CUANTO:** El estatuto federal *Disaster Mitigation Act of 2000* (en adelante, "DMA 2000") proporciona la base legal de los requisitos de planificación de mitigación de la Agencia Federal para el Manejo de Emergencias ("FEMA", por sus siglas en inglés) para los gobiernos estatales y municipales como condición para la concesión de subvención de mitigación. La DMA 2000 enmendó el *Robert T. Stafford Disaster Relief and Emergency Assistance Act*, 42 U.S.C. § 5141 (2000), derogando las disposiciones anteriores sobre la planificación de mitigación. A su vez, las reemplazó con un nuevo conjunto de requisitos que enfatizan la necesidad de las entidades estatales, locales y territoriales de coordinar estrechamente los esfuerzos de planificación e implementación de mitigación. El requisito de un plan estatal de mitigación continúa como condición para la asistencia por desastre.

**POR CUANTO:** A esos efectos, la Sección 322 del *Robert T. Stafford Disaster Relief and Emergency Assistance Act*, 42 U.S.C. § 5165 (2000), y la reglamentación federal promulgada para ese fin, disponen que para que los gobiernos estatales y municipales puedan recibir fondos de los programas federales de asistencia por desastre, deben preparar y someter para la aprobación del Presidente de los Estados Unidos, a través de FEMA, un plan de mitigación que describa los procesos para identificar los peligros naturales, riesgos y vulnerabilidades de la zona bajo su jurisdicción. Actualmente, el plan debe ser revisado, actualizado, y presentado para la aprobación del Gobierno federal cada cinco (5) años.

**POR CUANTO:** Previo a su presentación a FEMA, la reglamentación federal, 44 C.F.R. § 201.4(c)(6) (2014), requiere que el plan sea aprobado formalmente por el Estado. Conforme a la guía de revisión del plan de mitigación publicada por FEMA (en inglés, "*State Mitigation Plan Review Guide*"), y con fecha de vigencia de marzo 2016, el gobierno estatal debe proporcionar la documentación de la adopción oficial por el más alto funcionario electo o designado antes de la revisión final y aprobación por parte de FEMA.

**POR CUANTO:** Mediante el Boletín Administrativo Núm. OE-2011-039, el Plan Estatal de Mitigación de Peligros Naturales de Puerto Rico, Revisión 2011 (en adelante, "PEMPN-2011"), fue adoptado oficialmente, por el entonces Gobernador Luis G. Fortuño, como plan de mitigación oficial del Gobierno de Puerto Rico. El plan fue aprobado por FEMA el 16 de septiembre de 2011. Aunque en ese momento la reglamentación federal establecía el término de tres (3) años para revisar el plan de mitigación estatal, en el 2014 se enmendaron los requisitos de presentación de los planes de mitigación, 44 C.F.R. § 201.4(d) (2014). Debido a ello, se amplió de tres (3) a cinco (5) años la frecuencia con la que los estados deben presentar la actualización de sus planes de mitigación a FEMA. Como resultado, la enmienda tuvo el efecto de extender la vigencia del PEMPN-2011 hasta el 15 de septiembre de 2016.

**POR CUANTO:** Aunque los eventos de peligros naturales tienen consecuencias sobre la vida, propiedad, economía y ecosistemas de un país, estos efectos pueden reducirse si se identifican los riesgos y se desarrollan medidas para reducir la vulnerabilidad. Es por ello que la actualización y aprobación de Plan Estatal de Mitigación de Peligros Naturales es fundamental para que el Gobierno cuente con una herramienta sólida,

junto a otros planes, procesos y proyectos de planificación, en la mitigación de peligros del Estado Libre Asociado de Puerto Rico.

**POR TANTO:** YO, ALEJANDRO J. GARCÍA PADILLA, Gobernador del Estado Libre Asociado de Puerto Rico, en virtud de los poderes inherentes a mi cargo y de la autoridad que me ha sido conferida por la Constitución y las Leyes del Estado Libre Asociado de Puerto Rico, por la presente ordeno lo siguiente:

**PRIMERO:** Se adopta el Plan Estatal de Mitigación de Peligros Naturales de Puerto Rico, Revisión 2016 (en adelante, "PEMPN-2016") como el plan de mitigación oficial del Estado Libre Asociado de Puerto Rico.

**SEGUNDO:** Las entidades gubernamentales identificadas en el PEMPN-2016 implementarán las acciones de mitigación allí señaladas y presentarán un informe semestral (dos [2] veces al año) sobre el progreso y cumplimiento de las referidas actividades a la Oficina de Mitigación de Riesgos Naturales y Tecnológicos de la AEMEAD.

**TERCERO:** La Oficina de Mitigación de Riesgos Naturales y Tecnológicos de la AEMEAD rendirá al Gobernador un informe anual sobre el progreso de la ejecución del PEMPN-2016. Este informe será presentado antes del treinta (30) de abril de cada año.

**CUARTO:** DEROGACIÓN: Esta Orden Ejecutiva deja sin efecto el Boletín Administrativo Núm. OE-2011-039, y cualquier otra Orden Ejecutiva que sea incompatible en todo o en parte con esta, hasta donde existiera tal incompatibilidad.

**QUINTO:** VIGENCIA Y PUBLICACIÓN: Esta Orden entrará en vigor inmediatamente. Se ordena su más amplia publicación.

EN TESTIMONIO DE LO CUAL, expido la presente Orden Ejecutiva bajo mi firma y hago estampar en ella el gran sello del Estado Libre Asociado de Puerto Rico, en San Juan de Puerto Rico, hoy 17 de mayo de 2016.

ALEJANDRO J. GARCÍA PADILLA
GOBERNADOR

Promulgada de acuerdo con la ley, hoy 18 de mayo de 2016.

VÍCTOR A. SUÁREZ MELÉNDEZ
SECRETARIO DE ESTADO DESIGNADO

3

# INTRODUCTION

The Puerto Rico State Natural Hazards Mitigation Plan (PEMPN) responds to the mandate of the federal "Disaster Mitigation Act" of 2000 (DMA 2000), as amended. The DMA 2000 provides the legal basis in order for the Federal Emergency Management Agency (FEMA), to define and establish the requirements and conditions, for the state and local government (municipal), to receive federal financial assistance to relieve the damages caused by natural hazards. Puerto Rico has effectively complied with the requirements of this Act since its beginning, and this document is intended to update the 2011 Mitigation Plan (approved on September 16, 2011). It is important to note that federal regulations established a 3 year period to review the State Mitigation plans, however on April 25, 2014 the Mitigation Plan Regulation was amended in "Code 44 of Federal Regulations (CFR) Part 201" in order to reduce the frequency in which 3 to 5 year State Plan updates are made. This amendment was effective May 27, 2014 and had the purpose of correcting the term of the Puerto Rico Natural Hazards Mitigation Plan from 2011 to September 15, 2016. The PEMPN update was also made following the FEMA "State Mitigation Plan Review Guide" which became effective on March 6, 2016, and replaced the "Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000" (January 2008).

Natural hazard events cause great impacts on life, property, economy and natural systems, among others. However, these effects can be reduced if the risks are identified and measures are taken to decrease vulnerability. Puerto Rico has the information and the necessary tools to reduce the effects of natural and unnatural hazards. In addition, this PEMPN update is another fundamental tool in the process of reducing the vulnerability to hazards. To update the PEMPN the concept of Strategic Planning was used as a theoretical framework. This theoretical

framework allows the identification of the system's strengths and weaknesses, within their geographic, political and economic environment, in order to propose strategies or courses of action to address the problems faced, specifically regarding the study and management of natural hazards and those created by human activity that could pose potential threats to life, property and the countries ecosystems. The PEMPN integrates Municipal Mitigation Plans (local planning), which identify the risks, strategies and other aspects that municipalities establish in their plans.

The 2016 PEMPN update takes place during a historical moment where the country is experiencing socio-economic characteristics that directly impact the state's capacity to propose and implement strategies in hazard mitigation, as in all government administrative and operational areas. Puerto Rico faces a recession in economic activity that has resulted in a significant decrease in the resources available to meet its government operations. In addition, there has been a fundamental downgrade in the ability to pay the country's external debt, which has brought further deterioration in their creditworthiness and limitations on capital markets.

As an effect directly related to the previous topic, for the first time in its history, Puerto Rico has altered its population growth to a negative rate. That is, a significant sector of the population has chosen to leave the country in search of more favorable economic conditions for their families, mainly in different states of the United States. This trend continues to the present, as confirmed by the Federal US Census, and some expert demographers project it could increase in the coming years. This will have a significant effect on urban population concentrations and especially in municipalities where the impact of the economic recession has been greater.

Another particular aspect permeating the 2016 PEMPN update is the impact of climate change that the planet is suffering and is locally affecting all jurisdictions. This phenomenon, known as

"global warming" or "climate change" has important effects that should be attended due to Puerto Rico's condition as an island that may increase the level of vulnerability to certain hazards associated directly with climate change. On the other hand, it is important to take into account the social and economic factors affecting the country in order to delineate the mitigation strategy, as the Plan cannot function as an isolated tool or mere requirement of law. The 2016 PEMPN becomes a robust mitigation tool when implemented with other plans, processes and projects that impact development planning and hazard mitigation in Puerto Rico.

# CHAPTER 1: PLANNING PROCESS

The basis of planning, especially strategic planning in the Puerto Rico State Natural Hazards Mitigation Plan (PEMPN), is to carry out a process as a basis for studying the magnitude and the potential effects that natural hazards may have in the country and, based on that study, formulate and implement mitigation strategies in order for the State Government to adequately prepare and reduce the negative effects that may be caused by natural hazard events that can affect life and property. With this premise as a basis, and in response to compliance with the Federal Law, the Government of Puerto Rico has developed the 2016 PEMPN as the main instrument to guide mitigation efforts that could potentially affect the island. The PEMPN has been prepared under the direction of the Puerto Rico State Emergency Management and Disaster Administration Agency (AEMEAD), as a requirement of the federal law "*Disaster Mitigation Act*" of 2000 (DMA 2000).

## 1.1 Purpose of the Plan

The main purpose of PEMPN is to reduce vulnerability and the loss of life and property that are generated by the impact of natural and unnatural hazards through the development and implementation of a coordinated mitigation strategy between the Central Government, Municipalities and the citizens. The PEMPN seeks to develop a short and long term mitigation government policy that meets the requirements established by FEMA and can evolve to the extent in which the country develops and responds to the multiple socio-economic, demographic and environmental changes occurring. The PEMPN is also a requirement to obtain federal

subsidies in the event of disaster declarations and other federal programs offered by FEMA and the US Department of Homeland Security.

## 1.2 Planning Process Documentation

### 1.2.1 Plan Update Process

The PEMPN was initially prepared by AEMEAD in 2004. As noted above, the PEMPN should be updated and reviewed in a 5-year period since its last approval in 2011 as part of the new requirements of law. This revision of the 2016 PEMPN used the 2011 PEMPN as base and both the review and updating were led by AEMEAD.

The AEMEAD was created in 1976[1] with the primary purpose of handling emergencies caused by natural or human hazards as well as to implement activities to prevent and mitigate them. This purpose of AEMEAD is carried out through an integrated approach, in which activities are coordinated in order to meet the requirements and basic needs of an emergency or disaster through the interaction of the four (4) phases of emergency management: preparation (before), mitigation (before and after), response (during) and recovery (after). The mission of AEMEAD is to coordinate all the government resources of the Commonwealth of Puerto Rico, as well as those of the private sector to provide fast and effective services before, during and after emergency situations to ensure the protection of life and property of citizens..

1 In 1976 the State Civil Defense Agency of Puerto Rico was created by Act 22; in 1999 the Act was repealed to make way for Act 211. Act 211 renames the State Civil Defense Agency to Puerto Rico State Emergency Management and Disaster Administration Agency, and transfers all resources, functions, powers and duties from the Civil Defense and adds new responsibilities..

The Organizational Structure of AEMEAD is intended to address the activities required by an emergency or disaster. It is composed of the following areas:

- Office of the Director
- Office of the Assistant Director
- Press and Public Relations Office
- Administration Area
- Finance and Budget Division
- General Services Division
- Human Resources Division
- Center for Information Systems
- Preparation Division
- Recovery Division
- Response Division
- Mitigation Division
- Regional Offices

The AEMEAD offers its services through Island-based Regional Offices. The 12 Regional Offices called Zones foster rapid response and closer attention to communities. The 12 zones are: Zone I: San Juan, Zone II: Vega Baja, Zone III: Arecibo, Zone IV: Aguadilla, Zone V: Mayagüez, Zone VI: Ponce, Zone VII: Utuado, Zone VIII: Comerío, Zone IX: Guayama, Zone X: Caguas, Area XI: Humacao and Zone XII: Ceiba. The map below includes all Zones and the municipalities that compose them..

**Map 1**
**Regional Offices Distribution**
**State Emergency Management and Disaster Administration Agency**

The AEMEAD delegated the management and direction of PEMPN to its Mitigation Division, so that their requirements are effectively completed. Following the requirements established by FEMA in the document: *State Mitigation Plan Review Guide*, effective March 6, 2016, which replaced the *Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000,* PEMPN has been based on a strategic planning and participatory process, adding the private sector, organizations, general public and government sectors at all levels as partners in the planning process.

To guide the planning process and encourage the participation of government agencies, the strategy in the revised 2011 PEMPN to incorporate working committees with specific responsibilities in various stages of development was maintained in this Plan. The committees that participated in the process of reviewing and updating the PEMPN were: *Planning Steering Committee*, *State Emergency Management Committee*[2], hereinafter

[2] This Committee was created in 1999 by *Executive Order No. OE-2001-26 for the purpose of establishing*

called the *Emergency Committee and Interagency Committee for Disaster Mitigation and Technology*[3]. As illustrated in the flow diagram of the Planning Process in Appendix 1-A, all working committees involved in drafting the PEMPN responded to the Planning Steering Committee. The integration of interagency committees was crucial since their representatives served as intermediaries between their respective agencies and the Steering Committee in the process of gathering information and statistical data needed for the various stages of processing PEMPN.

As part of the effort to encourage the participation of different sectors of society, several citizens that represent various professional specialties such as environmental scientists, planners, engineers, architects and environmental groups were invited. The call aimed to integrate different sources of knowledge to gather technical and vocational studies in the areas of natural hazards mitigation as part of a Citizens Committee. The purpose of consulting the public was to assess the state's current capacity to implement mitigation measures and obtain professional and technical input regarding mitigation priorities in general and in specific communities. In addition, it must integrate new knowledge and alternatives to meet the challenges the country faces due to the effects of climate change caused by global warming.

Another component of citizen participation was the invitation to public meetings. Public notices were posted in the countries general press to all citizens interested in hearing the PEMPN objectives and providing input and recommendations on issues related to natural

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*coordination of executive duties in emergencies and disasters management and repeal Administrative Bulletin OE-1993-23 and 4974-E.*

[3] Idem.

hazards that affect their communities. At the public meeting celebrated on March 3, 2015, components of PEMPN were presented and space was open for citizens and stakeholders interested in taking part of the preparation of the Plan through a Citizens Committee.

Once the final draft of PEMPN was completed citizen participation was again convened through a second public notice in the countries general press, in which the public was invited to review the PEMPN draft and submit comments and recommendations to be later incorporated into the final draft of the Plan. The PEMPN draft was available during the period from April 4 to 18, 2016 in digital format on the AEMEAD website. In addition, physical copies of the plan draft were available during the same period in the following four AEMEAD offices: Central Bureau of AEMEAD-San Juan, Mayaguez Zone, Ponce Zone and Humacao Zone. During the period the 2016 PEMPN draft was available for review and comment, none were received.

The 2011 PEMPN was used as a base to update the areas corresponding to the requirements of vulnerability analysis, identification and evaluation of natural hazards and a request was made to all government agencies that had recent databases and were related to vulnerability to natural hazards assessment, and inventories of critical infrastructure to electronically submit them for evaluation, and if determined useful, be incorporated into PEMPN databases. The Puerto Rico Planning Board provided most of the data, maps and recent aerial photos that are relevant to the Plan. With the information gathered, new maps of vulnerability to different hazards were created and new databases concerning critical infrastructure were added.

As additional important information the most recent population data available at the US Census Bureau as well as information generated by the Puerto Rico Planning Board were used in the implementation of the HAZUS project that estimates, among other variables, potential losses caused by natural hazards for municipalities of Puerto Rico.

The review and updating of the State Natural Hazards Mitigation Plan was completed in a period of approximately 18 months.

### 1.2.2 Strengths and Weaknesses of AEMEAD

AEMEAD's public policy is to protect the people of Puerto Rico in emergencies or disasters affecting the island and providing the quickest and most effective necessary assistance for the protection before, during and after these events, ensuring the protection of life and property. The implementation of its public policy is the greatest strength AEMEAD possess, which is supported by various components and actions listed below:

- Extensive and proven organization throughout the island and its communities
- Qualified and properly trained personnel, as well as countless volunteer groups throughout the island.
- Proper management of human, technical and fiscal resources
- High aid and support of citizens in the functions of the Agency
- Extensive experience in handling emergencies at the local and state level

However, it is important to note that the current fiscal situation of the Commonwealth of Puerto Rico may limit the AEMEAD capacity to execute strategies and mitigation

activities, as well as its operational activities. Some of the limitations that AEMEAD may face, taking the fiscal crisis of Puerto Rico into account, are:

- Budget reductions in several of its departments and agencies.
- Reduction in human resources and training activities, operation and maintenance
- Deterioration in physical structure and equipment due to budget cuts
- Other effects caused by the unavailability of funds

Proven strengths of AEMEAD demonstrate that it can meet the challenges it probably faces due to the fiscal crisis. In addition, the approval of PEMPN is a fundamental tool for AEMEAD because in addition to providing an assessment of the impact of potential natural hazards, it also presents strategies to mitigate them.

### 1.2.3 Assessment Procedure of the 2011 PEMPN

The State Mitigation Plan evaluation and updating process prepared in 2011 was developed at various levels.

- First of all, a comprehensive review of the document was performed by the members of the Planning Steering Committee. The purpose of this comprehensive review was to carry out a full analysis and reading of the 2011 PEMPN in order to establish general consensus of the level and magnitude of changes that would be required to update each of the sections of the Plan. Once this assessment was completed, the activities and information needed were determined to update PEMPN chapters.

- Secondly, the Goals, Objectives and Mitigation Actions proposed in the 2011 PEMPN were evaluated from two points of view: the level of compliance and the opportunity to recommend if the goal, objectives and mitigation action should be maintained. The combination of these proposals is one of the most important parts of this planning document. In this process the participation of the various working committees established to guide the planning process in updating the PEMPN was encouraged. The level at which each of the proposals of the 2011 PEMPN was met provides valuable information regarding the need to remain in or evolve in the 2016 PEMPN and to determine measures and priorities to promote a more effective implementation. Appendix 1-B presents a table in which the result of the evaluation of the Goals and Objectives proposed in the 2011 PEMPN are shown. This evaluation was coordinated by the AEMEAD Mitigation Division and it incorporated the persons handling the implementation of mitigation activities that take place on the island.

- In third place, the input that was provided by all participants (direct and indirect) in the development of the 2016 PEMPN during the period of consultation and discussion was used. That is the data and information provided by the working committees, state and federal government agencies and the contributions, comments and information that were obtained as part of the process of public discussion by professionals, interest groups and private citizens. The recommendations and changes that emerged from this evaluation approach were incorporated during the update process of the 2016 PEMPN.

### 1.2.4 Coordination with Government Agencies

One of the first efforts in the process of updating the PEMPN was to establish mechanisms to facilitate the participation of the greatest possible number of governmental agencies in the various components of the Plan. The preparation of the PEMPN is not defined as the product of one agency in particular as is the AEMEAD, but that the Agency acts as the axis which coordinates all efforts and activities that are required for its the preparation. Each Government Agency has different levels of participation in the development of the Plan, including the provision of data and information, input in the evaluation of the 2011 Plan, recommendations on strategies and participation in the assignment of priorities that should be addressed in the next five years of validity of the 2016 PEMPN. This participation was obtained through mechanisms such as telephone calls and letters inviting the agencies to participate in working committees, presentations and discussion meetings.

The Planning Steering Committee acted as a central axis in the whole process and was in charge of the evaluation of recommendations and comments made by the working committees and public meetings to incorporate them into the various sections of the Plan, based on the requirements of Law and the specific priorities of Puerto Rico. As noted above, the development of PEMPN used a participatory and strategic planning approach that involved the coordination and participation of state and federal agencies, and the private and academic sectors, among others. Below is a detailed description of the participation of different sectors and committees in the PEMPN.

***Planning Steering Committee***

The Planning Steering Committee had the primary responsibility of carrying out the corresponding tasks of updating the PEMPN; therefore, it was responsible of directing the planning, decision making and drafting of the Plan. The Committee was represented by:

- Office of the Governor's Authorized Representative (GAR) who is in charge of executing the agreements between the Federal and State Government and representing the Government of Puerto Rico.
- State Emergency Management and Disaster Administration Agency (AEMEAD), specifically the Mitigation Division staff of AEMEAD, office responsible for coordinating and working the appropriate management tasks corresponding to the assessment and development of PEMPN.
- JM Professional Planning Consultants, PC, consultants hired by the AEMEAD to develop the PEMPN update.

Other hierarchy officials in the decision making participated in meetings with the Planning Steering Committee, as needed.

This Committee was also responsible for designing and coordinating the participation process for evaluating and updating the PEMPN. In addition, it evaluated the recommendations issued by other Working Committees and other Government Agencies, as well as the recommendations and opinions of citizens, and determined those that could be accepted. The criteria used to pass judgment on the recommendations were based on

the analysis of vulnerability as well as the vulnerability assessment and priorities established by the Municipalities in their respective Local Mitigation Plans.

***State Emergency Management Committee***

This Committee, represented by 57 State and Federal Government agencies or instrumentalities, had the primary responsibility to provide public policy recommendations, strategies and priorities of the Plan and reinforcement functions in emergency management throughout the island. The State Emergency Management Committee exists prior to the preparation of PEMPN created by Act 211, Article 10 of August 2, 1999 (*Commonwealth of Puerto Rico Emergency Management and Disaster Administration Agency Act*). A list of the agencies that constitute this Committee is included in Appendix 1-C. This committee's responsibilities include:

- Support AEMEAD's resources and capacities
- Establish an Emergency and Disaster Management Office within the agency
- Appoint a full-time Interagency Coordinator, which has the authorization of the Head of Agency to make decisions, commit resources and funds within the operational framework of the agency
- Prepare and update a response Plan for the Agency in the event of emergencies or disasters.

***Interagency Committee for the Mitigation of Technological and Natural Hazards***

The Interagency Committee for the Mitigation of Technological and Natural Hazards was also formed prior to the preparation of PEMPN; as mandated by Act 211, Article 11 of

August 2, 1999 (*Commonwealth of Puerto Rico Law Emergency Management and Disaster Administration Agency Act*). It is composed of representatives from 16 central government agencies and the American Red Cross and had the responsibility of reviewing the goals, objectives and mitigation actions set out in the 2011 PEMPN. Appendix 1-D shows the composition of the Mitigation Committee.

**Federal Agencies**

As part of the PEMPN planning process, Federal Agencies were invited to participate in the planning process and were asked for their input regarding natural hazard inventories, vulnerability studies, and the implementation of future mitigation. The criteria used to select Federal Agencies were their relevance in planning and / or financing of mitigation activities and the management of natural disasters. Some of the agencies or Federal Offices consulted were: U.S. Geological Survey, USDA Rural Development, US Army Corps of Engineers, Federal Emergency Management Agency, and Caribbean Environmental Protection Division, among others.

## 1.3 Public Participation

### 1.3.1 Participation of Professionals y Interested Groups

The participation of specialized academic and institutional entities was requested to contribute with their knowledge and particular studies to the various activities required for the preparation of PEMPN. The aim was for respondents to provide technical information, related studies and geographical electronic files to analyze and use in the

preparation of PEMPN. The invitation was made through official letters explaining the objectives of PEMPN and requesting their participation.

### 1.3.2 General Public

Two opportunities to receive input from citizens were provided. The first was holding a public meeting on March 3, 2015. The second chance for public participation was the opportunity given to review the PEMPN draft during the period from April 4 to 18, 2016 through the AEMEAD website and the following four AEMEAD offices: AEMEAD Central Offices-San Juan, Mayaguez Zone, Ponce Zone and Humacao Zone.

Appendix 1-E includes copies of letters to state and federal agencies requesting data and information. Appendix 1-F includes agendas, attendance sheets, presentations and other documents evidencing the planning process and public and interagency coordination. Appendix 1-G includes copies of the two public announcements made through local newspapers in the country calling for public participation during the PEMPN update process. In addition, the table below presents a summary of the main participation activities and interagency coordination that were conducted to update the PEMPN.

| TABLE 1.1: INTERAGENCY PARTICIPATION AND COORDINATION ACTIVITIES FOR PEMPN UPDATE<br>*Planning Committees, State Agencies, Federal Agencies and Consultant Firm* | |
|---|---|
| **ACTIVITY DATE** | **ACTIVITIES PERFORMED** |
| ➢ January 14, 2015 | Meeting to begin work, discuss strategies and present the Work Plan for the development of PEMPN. The meeting was held at the offices of the Puerto Rico Emergency Management and Disaster Administration Agency (AEMEAD) with Mr. Jesús Poupart, Mitigation Area Director, and Ms. Sarimar Hiraldo, Emergency Management Mitigation Area Specialist.<br>*Issues Discussed*<br>▪ Begin the 2011 PEMPN evaluation process to determine the level of changes and revisions that would be needed.<br>▪ Drafting, mailing and tracking letters to state agencies requesting data on hazards, vulnerability and critical facilities, among others.<br>▪ Drafting, mailing and tracking letters to academic and professional institutions to collaborate in the PEMPN update.<br>▪ Drafting, mailing and tracking letters to federal agencies requesting information related to PEMPN.<br>▪ Coordinating with government agencies to assess recent vulnerability studies. |
| ➢ January 19, 2015 | Coordination meeting with the firm GIS Consultants, Inc. to establish the tasks for the risk analysis, preparation of vulnerability maps and other analysis using the Geographic Information Systems (GIS). |
| ➢ February 3, 2015 | Meeting with the staff of the Office of the Governor's Authorized Representative (GAR) to establish the coordination of work, discuss the objectives and the PEMPN work plan.<br>*Issues Discussed*<br>▪ Data and information need for the review and updating of the 2011 PEMPN.<br>▪ PEMPN adoption procedures once the update is complete.<br>▪ Need to obtain the data on repetitive losses by municipality and process to obtain the data. |
| ➢ February 4, 2015 | Official letters were sent to all state and federal agencies that are important to the PEMPN, explaining the Plan objectives and requesting information on studies, projects and / or natural hazards mitigation activities in Puerto Rico. In addition, they were asked for databases that could be relevant for the inventory of natural hazards. |
| ➢ February 13, 2015 | Presentation of members of the AEMEAD Mitigation Committee in Zone 1: San Juan, in order to discuss and present the PEMPN objectives and encourage participation in the interagency review process. |

| TABLE 1.1: INTERAGENCY PARTICIPATION AND COORDINATION ACTIVITIES FOR PEMPN UPDATE *Planning Committees, State Agencies, Federal Agencies and Consultant Firm* | |
|---|---|
| **ACTIVITY DATE** | **ACTIVITIES PERFORMED** |
| ➢ February 16, 2015 | Public Notice publication in the general circulation newspaper El Nuevo Día to inform the public about the celebration of a Public Meeting. |
| ➢ March 3, 2015 | Celebration of Public Meeting at the offices of the AEMEAD. The meeting was attended by government agencies (AEMEAD and FEMA) and the general public. It aimed to integrate the general public in the process of updating the PEMPN, report on the objectives and proposed schedule, and provide orientation on participation mechanisms. |
| ➢ March 31, 2015 | Coordination and discussion meeting with FEMA and AEMEAD representatives.<br>*Issues Discussed*<br>▪ PEMPN law requirements<br>▪ Identify the status of the Municipal Mitigation Plans. Request that approved Municipal Mitigation Plans for the 2011-2015 period be incorporated in the revised PEMPN. FEMA will provide copies of approved municipal mitigation plans that AEMEAD does not have copies of.<br>▪ Discuss the review process and the implementation of new regulations of the Plan's various sections, effective from March 2016.<br>▪ Review the official FEMA publication, "A Guide for Integrating Disaster Data into Hazard Mitigation Planning" to use as a reference guide in the PEMPN updating process.<br>▪ FEMA defines the use of the current "Crosswalk" as a guide for preparing the PEMPN revision<br>▪ A request was made to work closely and to subject to review and comment the sections of the PEMPN as they are completed. |
| ➢ April 28, 2015 | Meeting with Ms. Yamira Vallés, Director of the Planning Board Information System Office to discuss PEMPN objectives, identify databases on natural disasters inventory, Board initiatives and procedures for data and maps collection.<br>*Issues Discussed*<br>▪ Need for data and information to carry out the process of updating the PEMPN. To obtain data, a formal request is required according to Act 211 to hand in the Planning Board "shape files" to the AEMEAD.<br>▪ Levels of information that the Planning Board has and could provide to meet the update needs of the PEMPN. Among |

| TABLE 1.1: INTERAGENCY PARTICIPATION AND COORDINATION ACTIVITIES FOR PEMPN UPDATE<br>*Planning Committees, State Agencies, Federal Agencies and Consultant Firm* | |
|---|---|
| **ACTIVITY DATE** | **ACTIVITIES PERFORMED** |
| | them: maps of areas prone to flooding, tsunamis maps, aerial photos, critical infrastructure data (roads, AAA water distribution system, AEE electrical distribution system, schools, hospitals, ports and airports, shelters, bridges and telecommunications, among others.) in addition, "information layers" on soil types and Puerto Rico geology.<br>▪ Programming of the HAZUS implementation project by the PR Planning Board (JPPR, by its acronym in Spanish) and availability of data for updating the PEMPN. |
| ➢ May 6, 2015 | Meeting with the Planning Board staff for the purpose of identifying information sources on the effects of climate change and the latest information on floodplains and tsunamis studies. |
| ➢ August 2015 | The period to gather Municipal Mitigation Plans ended. To this date 64 Municipal Mitigation Plans were provided by the corresponding agencies. These plans were reviewed and a summary was prepared for each one which included: defined goals and objectives, hazards to which they are exposed, potential losses associated with each risk and mitigation projects or strategies. The summary for the 64 Municipal Mitigation Plans was included in Chapter 5: Local Coordination and Mitigation Capabilities. |
| ➢ June 4, 2015 | Meeting with representatives of the Office of GAR at AEMEAD, to discuss the progress of the project |
| ➢ February 4 and 11, 2016 | Meeting with AEMEAD Mitigation Division staff to discuss the progress of the project, the changes that would be incorporated into the goals, objectives and mitigation actions, and to prioritize mitigation actions. |
| ➢ Several Dates | List of other efforts that were made in order to continue and accelerate the PEMPN updating process and promote interagency participation:<br>▪ Periodic progress reports on the status of PEMPN<br>▪ Short meetings with key personnel in several FEMA and AEMEAD offices<br>▪ Telephone and email communications<br>▪ Efforts were made with FEMA and the Office of GAR to obtain copies of Municipal Mitigation Plans approved during the 2011 to 2015 period.<br>▪ Monitoring efforts were made to the original request for information. |

| TABLE 1.1: INTERAGENCY PARTICIPATION AND COORDINATION ACTIVITIES FOR PEMPN UPDATE<br>*Planning Committees, State Agencies, Federal Agencies and Consultant Firm* | |
|---|---|
| **ACTIVITY DATE** | **ACTIVITIES PERFORMED** |
| ➢ March 18, 2016 | Publication of a Public Notice on the availability of the PEMPN draft for review. Citizen comments in El Nuevo Día, general circulation newspaper. |
| ➢ April 4-18, 2016 | Period in which the PEMPN draft was available for review on the AEMEAD website and at the AEMEAD Central Office-San Juan, Mayaguez Zone, Ponce Zone and Humacao Zone. |

## 1.4 Integration with Other Planning Processes

It is important to take into account and integrate other state and municipal planning processes that exist in the country to update PEMPN because many of these processes affect the mitigation of natural disasters. Some of these efforts, processes or laws are discussed below.

***Activities and Mitigation Plans of the Agencies within the Interagency Committee for Risk Mitigation***

Act 211 establishes mitigation goals that all state agencies must follow. These mitigation goals include that each Agency's Committee should coordinate and prepare mitigation plans and activities for their respective agencies for the purpose of protecting the life of their employees and visitors, and their facilities. In addition, agencies mitigation plans should aim to ensure the continuity of services offered or their restoring as soon as possible after an emergency event.

***Permits Management Office***

The roles of the Permits Management Office (OGPe, before known as ARPE) directly affect risk mitigation as it is responsible for evaluating and granting or denying permits that were formerly under the jurisdiction of the Regulations and Permits Administration (ARPE). The Permits Management Office through their Managers determines the environmental compliance of all actions subject to an environmental impact analysis under Act 416 of September 22, 2004, as amended, known as the "Environmental Public Policy Act" of Puerto Rico; and after reaching interagency agreements, will issue permits, certificates, licenses or government documents required for construction and land use purposes required to carry out or operate businesses in Puerto Rico.

### *Municipal Territorial Ordinance Plans*

The Territorial Ordinance Plans (POT) developed by the municipalities are directly related to natural hazards mitigation because they provide municipalities with mechanisms to regulate the use of land and manage urban and rural development. It also provides the tools to implement the particular plans and regulations they deem necessary to address their territory. Land management planning is directly related to risk mitigation as it provides the tools to control development in areas most at risk and promote development in those where the risk is lower.

### *Puerto Rico Land-Use Plan*

The Puerto Rico Land-Use Plan (PUT) is a fundamental tool for planning and hazard mitigation. The PUT, effective November 19, 2015, formulates goals, objectives and strategies that allow the country's development. One of the PUT goals that reflects its impact on hazards mitigation is to *preserve and protect natural, archaeological or agricultural resources, rural soils and those environmentally sensitive to adverse effects of uncontrolled construction*. In addition, PUT establishes guidelines for mitigation and adaptation to climate change that are taken into consideration in the review of the 2016 PEMPN.

### *Planning Board*

The Planning Board (JP) is the agency responsible for managing the integrated economic, social and physical development of Puerto Rico. The Planning Board Organic Law states that the Board has the ministerial duty to prepare and adopt regulations and maps designed to guide an orderly

planning process and make decisions on land use; actions that directly impact natural hazards mitigation.

***Municipal Mitigation Plans***

A crucial part of the PEMPN review is the integration of the Natural Hazard Mitigation Plans which have to be developed by the 78 municipalities of Puerto Rico in order to identify hazards that directly affect their territory and identify actions to mitigate them. As part of the PEMPN upgrade, 64 municipal plans provided by the agencies that have to do with the PEMPN update process were reviewed.

## 1.5 Mission, Vision, Goals and Planning Objectives of PEMPN

The Mission, Vision, Goals and Planning Objectives of PEMPN are based on the general concept of encouraging the state and municipal governments to identify natural hazards that affect them, outline the actions and activities that are conducive to reducing losses that could cause these hazards, and establish a coordinated approach to implement the Plan, maximizing available resources. The mission presents the purpose of the PEMPN and the results it wants to achieve. The vision portrays how Puerto Rico should be in the future and, once the PEMPN is in its implementation phase, what it expects to achieve in the long-term. In general terms the mission, vision, goals and planning objectives proposed in the 2011 PEMPN have remained intact since they led the original preparation of the Plan, as well as its revisions.

***Mission***

The Puerto Rico Natural Hazard Mitigation Plan will help the Island minimize at long-term the negative impact of the identified natural hazards, including the new challenges

presented by climate change phenomena. This is achieved through an integrated mitigation public policy between the State and Municipal Governments and efficient management of mitigation activities designed in the Plan..

***Vision***

The island of Puerto Rico will be environmentally safe for its inhabitants, as it will reduce the maximum possible loss of life and property caused by natural hazards. It will institutionalize a mitigation public policy aimed at reducing the harmful effects caused by natural hazards, through its plans, laws, ordinances and regulations.

***Planning Goals and Objectives***

**GOAL 1:** Coordinate a process of public participation in the review and updating of the Plan that includes state and federal agencies and interest groups, in order to integrate the planning efforts of each group to the Plan.

***Objectives:***

a. To establish working committees to integrate the participation of different sectors: state and government federal agencies and interest groups.

b. Integrate state, municipal and FEMA efforts and / or mitigation activities to the Plan.

**GOAL 2:** Review vulnerability analysis and assessment of natural hazards in Puerto Rico, taking into account the updated information and technical and financial resources available to review and update the mitigation strategy.

***Objectives:***

a. To identify new information about potential, significant and non-significant natural hazards.

b. Assess the vulnerability of state critical facilities and their geographical distribution according to the identification of areas prone to natural hazards.

c. Estimate potential losses of state critical facilities and their geographical distribution according to the identification of areas prone to natural hazards.

**GOAL 3:** To design a mitigation strategy aimed at minimizing the negative impact of identified natural hazards.

***Objectives***

a. Document the mitigation strategy in the results of the studies, vulnerability assessments and natural hazards analysis conducted.

b. Incorporate vulnerability analysis and mitigation strategies outlined in the Municipal Mitigation Plans to review and update the strategy established in the PEMPN.

**GOAL 4:** To design effective coordination mechanisms to integrate the implementation of mitigation activities of the central and municipal governments.

***Objectives***

a. Define the criteria to prioritize the allocation of funds and technical assistance to municipalities, based on the results of vulnerability analysis and natural hazards assessment.

**GOAL 5:** Review and update the process of continuous evaluation of the Plan.

***Objectives***

a. Review and update the system for monitoring mitigation activities that will be implemented.

b. Review and update the system established for the review and continuous updating of the Plan.

## 1.6 PEMPN Adoption and Compliance Law Statutes

Review and update of the 2016 PEMPN was adopted by the Commonwealth of Puerto Rico on May 18, 2016 by Executive Order No. OE- 2016-021 that establishes the State's commitment in the implementation and execution of the proposed objectives, goals and activities. This Executive Order is presented at the beginning of the PEMPN document. In addition to the formal adoption of the Plan, the State in compliance with current regulations certifies that:

- The PEMPN has been prepared and reviewed following the requirements set by federal law Disaster Mitigation Act of 2000" (DMA 2000) and in compliance with the *State Mitigation Plan Review Guide-2016*.

- That as part of the Plan implementation, the State recognizes and certifies strict compliance with applicable federal regulations and statutes for grants funding as described in 44 CFR 13.11(c).

- In compliance with the requirements in 44 CFR 13.11(d), the state certifies the PEMPN will be amended in case of establishment of new regulations or federal statutes, changes in applicable state laws, as well as significant changes in the organization, public policy

or operation of the agency in charge of the implementation of PEMPN and any amendment done during the effective period of the Plan will be added as an attachment to the original plan and then be incorporated into the appropriate sections when the next formal review of the plan is carried out, as required by Section 201.4(d) of the Act.

# CHAPTER 2: HAZARD ASSESSMENT

The evaluation of risks or hazards that may affect Puerto Rico potentially is fundamental for the PEMPN since it allows to identify the vulnerability of the territory, its properties, infrastructure, and population. The hazard assessment has the purpose of identifying possible physical, economic, and social impacts, to establish a mitigation strategy directed to reduce or remove the impact and possibility of occurring emergencies or disasters. Also, the evaluation of hazards helps to prioritize the allocation of human, technical and financial resources required at the state and municipal levels.

## 2.1 Hazard that May Affect the Territory

The evaluation of potential hazards such as natural and non-natural, significant or non-significant, is a crucial task to elaborate the mitigation strategy and establish a continuous effort in future evaluations and updates of PEMPN. Following up the methodology used for the recompilation of data, and the description of the risks that may potentially affect Puerto Rico, among others:

### 2.1.1 Data Collection Methodology

The procedure used to revise the data collection to update the 2016 PEMPN was done in phases. As a first step, a comprehensive review of all information submitted in the 2011 PEMPN was conducted to confirm their accuracy and validity and thus identify the need for additional data collection. The reason for carrying out this process comes from the possibility that disaster events or emergencies happened during the period of the previous

plan, new technical studies were prepared to provide additional information, and new sources of information regarding the identification of natural hazards were identified.

The information sources included government agencies of state government, federal agencies, and private entities. Also, information contained was incorporated in the approved local mitigation plans that were available during the preparation of the PR-HMT with the purpose of making and incorporating them as a fundamental part in the priorities establishment and in the formulation of mitigation strategies. The municipality plans compendium is included in the Appendix 4-D, corresponding to Chapter 4 of the PEMPN. The revision of the municipality plan concentrated in identifying the following areas:

- Natural hazards that may affect the municipalities
- Estimated potential losses associated with the identified risks
- Goals and objectives of mitigation
- Mitigation activities or projects proposed by municipalities to deal with identified natural hazards

The data and information recompilation process of the different governmental and private sectors consisted in the request by letters directed to the agency heads, presentations to agency representatives and concerned entities, meetings with government officials and technical staff, and identification of technical studies made through FEMA and the GAR (Government Authorized Representative). In the Appendix 1-E corresponding to Chapter 1: *Planning Process* includes copy of the letters sent to the agencies requesting

information for the actualization of the PEMPN. The information that was requested to the governmental agencies consisted of:

- Inventory of critical facilities of the agency with information regarding each facility, such as location coordinates, vulnerability to identified natural hazards, replacement cost of the installation, and estimated contents replacement cost.

- Inventory of mitigation projects undertaken in the last three years and planned for the future, including information such as project type, location, date completed or is expected to complete, cost estimate and population that would benefit from the project.

The second step, consisted in the analysis of all the information presented in the 2011 PEMPN with the purpose of validating its accuracy, validity, and determine the update necessity. The third step was to update the geographic data bases generated in the 2011 PEMPN 2011 with the data provided by organizations, state agencies, and federal agencies. During this process, updated data was obtained, such as: flood risk caused by Tsunami, census data, and critical infrastructure localization. Also, the following new geodatabase was obtained: Wildfires, Evacuation Area in case of Tsunami, and Flood caused by Climate Change.

Among the geographical data of hazards provided by organizations and agencies, there are:

| POTENTIAL HAZARDS | |
|---|---|
| **Geographical Information Levels** | **Source** |
| Flood Zones (Flooding) | Federal Emergency Management Agency |
| Evacuation Area caused by Tsunami | Puerto Rico Seismic Network, UPRM |
| Wildfires | Texas Forest Service, US Forest Service-Puerto Rico |
| Increase in the Level Sea by Climate Change | National Oceanic & Atmospheric Administration |
| Tsunami (Flood Area) | Puerto Rico Seismic Network, UPRM |
| Earthquake | Puerto Rico Planning Board |
| Seismic Wave Caused by Earthquake | Puerto Rico Planning Board |
| Landslide Caused by Earthquake | Puerto Rico Planning Board |
| Liquefaction Caused by Earthquake | Puerto Rico Planning Board |
| Landslide Caused by Rains | US Geological Survey |
| Strong Winds (Storms/ Hurricanes) | National Oceanic & Atmospheric Administration |

Geographical data related to population and housing were obtained of the US Census Bureau[4]. The data of the critical infrastructure was provided by different agencies of the Central Government.

4 US Census Bureau-TIGER Files 2015.

| CRITICAL INFRASTRUCTURE | |
|---|---|
| **Geographical Information Levels** | **Source** |
| Sanitary Sewer and Storm water, Treatment Plants, Water Service Lines and Tanks Reserve, among others | Aqueduct and Sewer Authority |
| Landfills | Solid Waste Authority |
| Transmission Lines, Substations, and Thermoelectric, among others | Electric Power Authority |
| Fire Stations | Fire Department of Puerto Rico |
| Roads, Bridges, Square Tolls, Stations and Urban Train Line, among others | Department of Transportation and Public Works |
| Educational Centers and Schools | Education Department |
| Communication Towers | Telecommunications Regulatory Board |
| Airports, Ports, and Heliports | Port Authority |

Once the technical and geographical bases were updated, an analysis began to determine the possible risks impact. Below is described the analysis of the geographical data in general terms.

The use of the set of the collected data allows to identify the population and the housing in each area of risk, as well as the possible impact in the critical infrastructure. To be able to evaluate the intensity of the general risk, all the geographical levels of risks group in a new level through a spatial geographical process by means of a geographical information system (GIS). With the GIS, risk elements were analyzed spatially over the population and housing units.

To carry out the analysis, each risk level was assigned with a valor of "intensity or risk probability", so that one could discern between the critical areas and others that are less critical to sort by priorities. The levels are:

- Level 1: Very Low
- Level 2: Low
- Level 3: Moderate
- Level 4: High
- Level 5: Very High

Regarding the levels of census geographical information, units by census blocks were used for being the smallest level of the census data collection, specifically the data concerning population and housing. The basis of census blocks was superimposed in each of the geodatabase risk, individually and then on the clustered. This way, through a new union routine, census data is transferred to those in risk creating new areas. This process allows to obtain an approximate of population and housing among each risk area calculating its space in square meters. This process was made for all the identified risk levels, with the purpose of obtaining the possible impact in the population and housing, by municipality with its respective place (in square meters).

For the risk analysis on critical infrastructure, the same exercise described above was made, but in this case the spatial identity function is used in those geodatabase that are points. This way, the level of risk is transferred to the data point (location of critical infrastructure). Once the data of each of the risk levels was obtained (individually), proceeds to create the aggregate risk level to obtain all the risks in one geodatabase. The final tables with the aggregated risk data serve as a tool to determine, first, an approximate of the population

and housing at risk, and second, the amount of infrastructure and the risk level in which it lays. In the case of population and housing, it is organized by municipality in a way that a rank may be created to determine priorities of acting and mitigation. These data bases are in Geodatabase format of ArcGIS since it is the format that is managed mainly in the Central Government Agencies, so they ca be used for evaluation and approbation of public and private projects and by the Municipalities in the development of local mitigation plans.

As final products of the above methodology, it is obtained:

- Databases and updated analysis of the hazards that affect the territory of Puerto Rico
- Geo-referenced maps of natural hazards
- Inventory of the affected areas in total terms and by municipality
- Inventory of critical facilities and infrastructure exposed to dangers
- Priority ranks based on the establishment of risk levels/ vulnerability by municipality
- Priority ranks based on the establishment of risk levels/ vulnerability for critical facilities.

### 2.1.2 Inventory of Potential Hazards

The update process of the 2016 PEMPN, as discussed, requires the incorporation of data and information that may had been produced in the last years about the identification, incidence, and other aspects of natural risks. The identification of natural risks, included in this Chapter, has been based on the criterion of the occurrence and intensity that have experienced the same in the territory of Puerto Rico during the last century, according

with the information available. The sources used for the identification of natural and technological hazards cited freely and are in the References section. The classification of natural hazards discussed in this section is restricted to natural phenomena with potential to cause significant damage to life and property.

## Description of Natural Hazards

### 2.1.1.1 Flooding

Puerto Rico's climate is tropical maritime. This means that we have a great influence of ocean currents as we enjoy warm temperatures and abundant rainfall throughout the year. Flooding is defined as the accumulation of water within a body of water and the overflow of excess water on the adjacent plains. According to the Planning Board of Puerto Rico, floods can occur anytime of the year, though, are more frequent in the months of June to November. The most severe floods generally occur when hurricanes or tropical storms pass over or near our area. The Planning Board defines a flood as a temporary condition which may be partial or complete; two or more acres of normally dry land, caused by the overflow of inland waters, or by the tide or by the rapid accumulation, or from surface water runoff from any source. Downpours and torrential rain may occur at any time, so due to steep slopes of the tributary streams, excessive rain is quickly carried downstream causing flash floods.

There are four (4) types of flooding in Puerto Rico:

a. *Flash Floods*: This is the most life-threatening to humans and is the cause of most deaths from natural disasters in the world. It happens quickly and

sometimes without warnings from the National Weather Service. Flash floods are the most difficult to predict and those requiring immediate action of people who are in danger of being affected. Several factors contribute to the occurrence of flash floods, but the two key elements are rainfall intensity and duration.

b. *Riverine Floods*: Once the rain has caused flooding of a river, it may become out of its banks for several hours or even days. This is known as riverine flooding. If the rain event continues for several hours and the intensity of the rain falls decreases but remains constant, it will be very difficult for the stream current to return to normal. The flooding of rivers and streams is more common in Puerto Rico. The plains lack of absorption capacity is the major cause of flooding damage.

c. *Coastal Floods*: In Puerto Rico coastal flooding is very common and it is associated with low pressure weather systems, including tropical storms and hurricanes. The winds can bring high tides causing serious flooding and surf on the coast. This occurs most frequently in the months of November to February where strong low pressure systems north of Puerto Rico are stationed for several days, thus generating high and dangerous waves that reach from the Mona Passage to the Anegada Passage. When a hurricane approaches, the combination of strong winds, its low pressure center and the shape of the coast, allow sea level rise and development of

storm surge. Coastal flooding also may be the result of tidal waves or tsunamis, which are the result of seismic or volcanic activity in the sea.

d. <u>*Urban Floods*</u>: In urban areas, lack of proper maintenance to drainage systems and floating debris swept away by the rains, prevent the water to flow into existing storm drains, streets and highways. Water accumulates and causes serious flooding threatening residential and commercial properties. Another element that contributes to this type of flooding is that the land loses its ability to absorb rainfall as a result of urban development such as roads, housing, and parking garages, among others.

In August 1978, the Government of Puerto Rico joined the National Flood Insurance (NFIP). The NFIP was created by an Act of Congress of the United States to make affordable flood insurance to property owners in communities that agree to implement and administer regulations for floodplain management and compliance with program requirements. The Planning Board of Puerto Rico was appointed by the Governor of Puerto Rico as a state agency responsible for coordinating the activities of the National Program of Flooding Valleys in Puerto Rico and the Island municipalities of Vieques and Culebra. The Planning Board is charged with primary responsibility for ensuring that regulations and maps comply with the regulations of the NFIP. The Board coordinates activities aimed at raising awareness among municipalities and the public on measures to minimize the risk to flooding. The Puerto Rico Flood Insurance Rate Maps (FIRMs) were originally created in 1978 and subsequently maps were published

in 1996. Currently, there are Special Flood Hazard Area Maps which came into effect on November 18, 2009.

### 2.1.1.2 Landslides Caused by Heavy Rains

Landslides occur when the conditions for the force of gravity exerts its influence on crustal materials. The term landslide includes a wide variety of land movement, such as rock falls, slope failures, and debris flow. This earth movement threatens life and property and can disrupt transit, dragging trees, houses, bridges and cars, among others.

Meteorological phenomena that cause intense and prolonged rainfall, such as tropical waves and tropical cyclones can trigger landslides. Population growth and poor construction exacerbates the susceptibility of Puerto Rico to experience landslides. Population growth means that, when there is scarce adequate space for construction of houses, many people build their houses in areas prone to landslides. Associated with this there is an increased demand for basic services such as water and waste management (water pipes, sanitary pipes, septic tanks, and storm sewer). When these are improperly located or constructed, they provide the conditions for landslides.

Among the many factors causing the formation of landslides, the most important are: soil type, slope or incline of the terrain, soil water saturation, erosion, the presence of depressions or cavities, human activities , and of course the occurrence of earthquakes. As stated in the Building Performance Assessment Team Report (BPAT) prepared after Hurricane Georges, "landslides will become

a major problem in the future as more houses are built and there is more development in areas susceptible to these risks" (FEMA, March 1999).

Many of the landslides that occur in Puerto Rico are in a special category of landslides known as "debris flow". The flow occurs in mountainous areas with significant slopes during heavy rains. The rain saturates the soil and causes the ground level and peel strength loss, usually where the ground makes contact with the bedrock. There are many types of landslides, however, associated with soil saturation by water:

- Slow landslides: slow and steady movement of soil or rock falls down the slope, often recognized by their content of tree trunks, twisted pieces of fences or retaining walls, tilted poles or fences.
- Debris flow: fast-moving mass which combines loose soils, rocks, organic matter, air infiltration and water to form a viscous flow that slides down the slope.
- Debris avalanche: fast or extremely fast debris flow range.
- Mud flow: mass rapid flow of wet material containing at least 50 percent sand, silt and clay particles.

### 2.1.1.3 Strong Winds (Tropical Cyclones)

Hurricanes and tropical storms are the most common natural hazard in Puerto Rico, with consequences of extensive damage and loss. Hurricanes are tropical weather systems with a higher intensity of sustained winds at 74 miles per hour.

They develop over warm waters and are caused by the instability created by the collision of warm and cool air. A hurricane is a type of tropical cyclone. Tropical cyclones are classified according to the intensity of their sustained winds, namely:

- *Tropical Depression*: An organized system of clouds with a defined circulation and maximum sustained winds which are less than 39 miles per hour. It is considered a tropical cyclone in its formative stage.

- *Tropical Storm*: An organized system of clouds with a defined circulation and maximum sustained winds which fluctuate between 39 and 73 miles per hour.

- *Hurricane*: A maximum intensity tropical cyclone at which the maximum sustained winds reach or exceed 74 miles per hour. It has a definite center with a very low barometric pressure in it. Hurricanes are classified into categories ranging from 1 to 5, and winds can reach over 155 miles per hour.

Hurricanes are dangerous because of their potential for destruction, their ability to affect large areas, their ability to form spontaneously, and their unpredictable movement. Hurricanes are often accompanied by high tides, storm surges, and heavy rains can cause landslides and flooding by swollen rivers.

### 2.1.1.4 Earthquakes

As most of the Caribbean, Puerto Rico is subject to significant risk from earthquakes. Earthquakes represent a particularly severe threat due to irregular

time intervals between these events, lack of adequate forecasts and the catastrophic damage that can occur as a result of a significant event of this nature.

An earthquake is caused by the release of stored energy within or along the edge of the tectonic plates of the Earth[5]. They are characterized by a sudden shaking of the earth. The severity of an earthquake depends on its place of origin (epicenter) and the amount of energy released. Upon the occurrence of the earthquake, seismic waves radiate from the earthquake source, causing the shaking of the earth. The severity of the tremor increases as energy is released, and decreases according to its distance from the epicenter. The tremors can be felt hundreds of miles from its epicenter. The intensity of shaking is the result of several factors, such as: the extent and type of earthquake, the distance from this, the area's soil conditions, and the relative orientation of the site with respect to the seismic event.

Among the damages earthquakes can cause are liquefaction, landslides, and significant damage to buildings and infrastructure. Liquefaction is a phenomenon that causes unconsolidated soils lose their strength and act like a viscous fluid (like quicksand) when these soils are subject to tremors due to an earthquake. The frequency and intensity of liquefaction that can occur during an earthquake is due to several factors including: the geological conditions of the area, groundwater depth, the tremor severity, and magnitude of the earthquake.

[5] The tectonic plates are defined as follows: "The outer solid layer of the Earth consists of about 12 plates that form, right on the surface, a mosaic similar to a puzzle. Each plate is like a puzzle piece. They move slowly rubbing at the edges, colliding head-on or separate. These movements are caused by earthquakes."

Earthquakes can cause landslides and other types of soils failure. Landslides are sudden movements of materials that emerge from the hills or mountains, free fall, sliding or rolling down. Landslides caused by earthquakes can occur on natural slopes, cut slopes on the ground, eroded rocks, or filled slopes. They are common in areas where they are abruptly cut off the slopes, on plain soils or fractured eroded rock. The frequency and intensity of landslides that may occur during an earthquake is due to several factors, including: geological materials contained in the area, the steepness of the slope and the water content of the material that glides, trembling land and the magnitude of the earthquake.

### 2.1.1.5 Tsunamis

A tsunami is a series of waves caused generally by a vertical displacement on the bottom (bed) of the sea caused by an earthquake under the seabed. They can also be caused by underwater landslides or volcanic eruptions in a given region. Internationally, tsunamis are known by the name of Tsunami, Japanese word that means *big wave in the harbor*.

The characteristics of a tsunami are very different in deep and surface waters. In deep water, waves travel at up to 500 mph speed comparable to that of an airplane, a "jet". The maximum height in the open sea is generally less than a foot high. For this reason, they tend to go unnoticed by ships at sea. Furthermore, the distance between subsequent wave crests is usually very large. However, as they approach coastal areas they greatly decrease in speed, dramatically increasing their height. These giant waves that can sometimes reach a height of more than 30

meters (98 feet) can cause large losses of life and property when they reach the coast.

Tsunamis may exhibit additional features. Their arrival could be announced by the retreat of the sea from shore or by a gradual increase in sea level along the coast. Usually, there is a loud roar of the sea and a sound like a plane flying at low altitude. Furthermore, additional noise can be caused by the effect of powerful and fast waves on the reefs, rocks or other objects that are drawn.

### 2.1.1.6 Drought

Drought is described as "long periods of abnormal weather enough for water shortages to cause serious hydrological imbalances in the affected area"[6]. In simpler terms, a drought is a period of unusual persistent dry weather that persists long enough to cause serious problems such as damage to agriculture and rationing in the provision of potable water to the population. The severity of a drought depends on the degree of impairment in humidity levels, duration and size of the affected area.

There are four main approaches that can define a drought.

- *Meteorological Focus*: a measure of deviation from normal precipitation levels. Due to climatic differences, which can be considered a drought in one country may not necessarily be a drought elsewhere.
- *Agricultural Focus*: refers to the situation where the amount of moisture in the soil does not meet the needs of a particular crop.

[6] American Meteorological Society, Glossary of Meteorology, An Update, Originally published on 1959.

- *Hydrological Focus*: occurs when surface water sources and groundwater are below normal.
- *Socioeconomic Focus*: refers to the situation that occurs when physical shortages in water supplies begin to affect people.

The main cause of any drought is the lack of rain or precipitation, this phenomenon is called meteorological drought and if it lasts leads to a hydrological drought characterized by a disparity between the natural availability of water and natural water demands. In extreme cases you can get to drought. The lack of precipitation for an extended period of time can have disastrous consequences for agriculture and metropolitan areas. In some areas of the country, it does not take long as several weeks without rain to cause damage to crops. These areas must take measures on consumption savings, such as rationing. Lack of water is a major constraint that seriously multiplies over time. At the environmental level we can mention:

- *Agricultural Consequences*: The lack of water for prolonged periods leads to lack of development of crops and livestock farming.
- *Forest Consequences*: The poor conditions of precipitation cause environmental damage to vegetation and create situations of fires in forest areas.
- *Supply Consequences:* Reductions in water supplies to reservoirs causes the reduction of potable water service to communities and rationing.

### 2.1.1.7 Climate Change – Global Warming

Climate change, potentially caused by pollution and global warming, is one of the greatest threats of this century. This natural phenomenon is affecting economic, social environment, and biodiversity worldwide, and Puerto Rico is no exception. The evidence from scientific studies developed in recent decades has confirmed that the emission of "greenhouse gases" in the atmosphere (such as CO2, methane, CFCs and nitrous oxide) have created changes in the Earth's climate that have triggered a series of negative impacts on it. The impacts of these climate changes have been observed for several decades by researchers in the areas of natural hazard management. In the book Understanding Globalization, published in 2003, Robert Schaeffer[7] summarizes the recent history of global warming and climate change, both from a scientific point of view and as a challenge for public policy. The author notes that the increase in global temperatures has had the effect on the polar caps melting, thus increasing sea levels and threatening coastal areas in all countries. Noting that most scientists agree that global warming phenomenon is real, Schaeffer claimed reliance on the automobile as a major cause in increasing levels of carbon dioxide (CO2) contributing to climate change.

Among the scientific literature on this topic, highlights a report by the Working Group II of the Intergovernmental Panel on Climate Change (IPCC) in April 2007 where it predicts a wide range of negative impacts on global climate, together with cumulative evidence that changes in many physical and biological systems

[7] Robert K. Schaeffer, *Understanding Globalization: The Social Consequences of Political, Economic, and Environmental Change,* (Rowman & Littlefield Publishers, Inc., Oxford, 2003).

are related to the heat generated by man. Some of the projected impacts of climate change include: severe storms and flooding, food shortages and water, increased range of pests and diseases typical of tropical areas, and desertification of regions that are currently temperate.[8]

Climate change has an impact in the whole planet, which has led developing actions to mitigate it by different countries. For this reason, in the climate change convention (*Conference of the Parties*-COP-21) held from November 30 to December 11, 2015 in Paris, was adopted from nearly 200 nations, an agreement aimed at limiting the increase of global temperature to below 2 degrees Celsius. The Paris Agreement also states: *Recognizing that climate change represents an urgent and potentially irreversible threat to human societies and the planet and thus requires the widest possible cooperation by all countries, and their participation in an effective and appropriate international response, with a view to accelerating the reduction of global greenhouse gas emissions.*

Sea Level Rise

One of the main concerns to the scientific community in Puerto Rico is the rise in sea levels and the effect this may have on the structures and the population living in coastal areas. This, without taking into consideration the incremental impact it can have on previously identified natural hazards such as coastal flooding or tsunamis. Professionals such as geological and morphological Jose Molinelli Freytes have been studying and presenting recommendations aimed at reducing

[8] Intergovernmental Panel on Climate Change, *Climate Change 2007: Impacts of Climate Change – Impacts, Adaptation and Vulnerability – Summary for Policymakers,* Working Group II Report, April 2007.

the development and gradual removal of residents and infrastructure of the country's coastal areas as a preventive measure to the damage it may cause the increase in sea levels.[9]

A study conducted in 2005 by the Organization for Economic Cooperation and Development based in Paris, France, for the first time estimated exposure or vulnerability of the most important port cities to flooding due to storm surge and strong winds[10]. The research considered how climate change could impact some 136 cities around the world with coastal flooding in 2070, taking into consideration population growth and urbanization process. The city of San Juan, Puerto Rico was included in the study. According to it, as of 2005 and with current weather conditions, San Juan is ranked number 65 of total 136 cities in terms of population exposed to floods. The projection to the year 2070, San Juan ranks at number 63 with an estimated total of about 173,000 people at risk of being affected.

### 2.1.1.8 Hazards Caused by Humans

Disasters caused by malicious or criminal reasons, as well as those caused by accidental or neglect situations are events that can cause loss of life and property, environmental damage, and disruption of governmental, social, and economic activities. They occur when hazards impact settlements and their built environment. For purposes of the Plan, the dangers caused by humans have been identified as technological hazards and terrorism. These are distinct from natural

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9 El Nuevo Dia newspaper, Wednesday, February 27, 2008, "suggests reducing population density."

10 Nicholls, R. J. *et al. (2008), "Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes: Exposure Estimates*", OECD Environment Working Papers, No. 1, OECD Publishing.

hazards primarily in that the human-caused hazards are caused by human activities, while the risks posed by natural hazards, although they can increase or decrease as a result of human activities, are not inherently induced by humans.

Terrorism and Technological Hazards

Terrorism is officially defined in the Code of Federal Regulations as *"...the unlawful use of force and violence against persons or property to intimidate or coerce the government, the civilian population or any segment thereof, in the detriment of achieving political or social objectives."* (28 CFR, Section 0.85). The term *technological hazard* refers to incidents arising from human activities such as manufacturing, transportation, storage and use of hazardous materials. The FEMA 386-7 guide "Integrating Human-Caused Hazards Into Mitigation Planning" assumes that these technological emergencies are accidental and their consequences are unintentional.

For purposes of this Plan terrorist refers to weapons of mass destruction and includes those presented in Table 2-1.

## Table 2-1
## Characteristics of Terrorist and Technological Hazards

| HAZARDS | MODE OF APPLICATION | DURATION OF THE HAZARD | EXTENSION OF EFFECTS: STATIC/DYNAMIC | MITIGATING AND EXACERBATING CONDITIONS |
|---|---|---|---|---|
| **Conventional Bomb** | Detonation of an explosive device on or near the target. It can be done through a person, vehicle or projectile. | Instant; a secondary device may be used, extending the duration of the danger until it is determined that the site of attack is clear. | The extent of damage is determined by the type and amount of explosive. These are generally static, other cascade effect consequences, incremental weakening of the structure. | The energy decreases logarithmically as a function of the distance from the origin of the explosion. The terrain, vegetation, structures and so on, can provide a shield by absorbing and / or diversion of energy and debris. Exacerbating conditions include easy access to the target, no barriers or shields, poor construction and an easy cover-up of the device. |
| **Chemical Agent*** | A contaminant-aerosol liquid can be dispersed using sprayers or other aerosol dispenser, liquid vaporizers in pond containers or ammunition. | Chemical agents can be a viable threat for hours and weeks depending on the agent and the conditions under which it exists. | Contamination can be transported outside the initial area of the target by persons, vehicles, water and wind. Chemicals can be corrosive or harmful for a period of time if not remedied. | The air temperature can affect the evaporation of the aerosol. Soil temperature can affect the evaporation. Humidity can enlarge aerosol particles, reducing the inhalation of the agent. Precipitation can dilute and disperse the agent but can disperse pollution. Wind can disperse vapors, but also causes the "target" area to be dynamic. Micro-meteorological |

| HAZARDS | MODE OF APPLICATION | DURATION OF THE HAZARD | EXTENSION OF EFFECTS: STATIC/DYNAMIC | MITIGATING AND EXACERBATING CONDITIONS |
|---|---|---|---|---|
| | | | | effects of buildings and soils can vary the spread and duration of the agent. Shields by way of sheltering in place can protect life and property from the harmful effects. |
| **Arson** | Starting a fire or explosion in or near the "target" through direct contact or remotely via a projectile. | Generally minutes or hours. | The extent of damage is determined by the type and quantity of device, accelerant and materials present or near the target. These are generally static, others with cascading effect consequences, incremental weakening of the structure, and so on. | Mitigating factors include building protective systems and fire detectors and techniques of fire-resistant building. Inadequate security can allow easy access to the target, easy concealment of the incendiary device and not detect the initial fire. Failure to comply with fire codes and construction as well as failing to maintain fire protection systems available can substantially increase the effectiveness of firearm. |
| **Armed Attacks** | Tactical assault or fire from a hideout in a remote location. | Generally minutes or hours. | Varies based on the intentions and capabilities of the perpetrators. | Inadequate security can allow easy access to the target, easy concealment of weapons and non-detection of the beginning of the attack. |

| HAZARDS | MODE OF APPLICATION | DURATION OF THE HAZARD | EXTENSION OF EFFECTS: STATIC/DYNAMIC | MITIGATING AND EXACERBATING CONDITIONS |
|---|---|---|---|---|
| **Biological Agent*** | Liquid or solid contaminants can be dispersed using aerosol or linear point sources such as munitions, covert deposits and moving sprays. | Biological agents may pose viable threats for hours or even years depending on the agent and the conditions under which it exists. | Depending on the agent used and the effectiveness with which it has been deployed, contamination can be spread via wind and water. The infection can be spread by human and animal vectors. | The height of the dispersion on the ground can affect dispersion. Sunlight can be destructive to some bacteria and viruses, and moderate winds can disperse the agent but winds can break the clouds of spray. Micro-meteorological effects of buildings and terrain can influence aerosolization and travel agent. |
| Cyberterrorism | Electronic attack using one computer system against another system. | Minutes or days | Generally no direct effects on the built environment. | Inadequate security can facilitate access to a critical computer system allowing it to be used to conduct the attack. |
| **Agroterrorrism** | Direct contamination is usually disguised in food sources or the introduction of pests and / or pathogens in crops and livestock. | From days to months. | Varies by type of incident. The food contamination events may be limited by the discrete distribution of places, while pests and pathogens can be dispersed widely. Generally has no effect on the built environment. | Inadequate security can allow food to be adulterated and introduction of pests and pathogens to crops and livestock. |

| HAZARDS | MODE OF APPLICATION | DURATION OF THE HAZARD | EXTENSION OF EFFECTS: STATIC/DYNAMIC | MITIGATING AND EXACERBATING CONDITIONS |
|---|---|---|---|---|
| **Radiological Agents **** | Radioactive contaminants can be dispersed using aerosol sprays and point or line sources such as munitions, covert deposits and moving sprays. | Hazardous pollutants may be seconds or years depending on the material used. | The initial effects can be found at the scene of the attack, depending on weather conditions, the subsequent behavior of radioactive contaminants may be dynamic. | Duration of exposure, distance from the radiation source and the amount of shields between the source and the target for exposure to radiation. |
| **Nuclear Bomb**** | Detonation of a nuclear device underground, surface, air or a high altitude. | A "flash" of light and heat and a blast of a wave for a few seconds, and the nuclear radiation and the danger of radioactive fallout can persist for years. An electromagnetic pulse from a high altitude per second can affect only the unprotected electronic systems. | An initial light, heat and blast effects of underground, above ground or in the air are static and are determined by the characteristics of the device and its use. The fallout of radioactive contaminants may be dynamic, depending on weather conditions. | The harmful effects of radiation can be reduced by minimizing the exposure time. The energy of light, heat and blast decreases logarithmically as a function of distance from the origin of the explosion. The terrain, vegetation, structures, etc., can provide a shield for the absorption of heat and / or diversion of radiation and radioactive contaminants. |
| Dispersion of Hazardous Material *(in fixed facilities or while being transported)* | Polluting solids, liquids and gases can be released from fixed or mobile containers. | Hours to days | Chemicals can be corrosive or harmful over time. The explosion and / or fire may occur later. Contamination can be transported out of the incident area by persons, vehicles, water and wind. | Like chemical weapons, the weather will directly affect the development of danger. Micro-meteorological effects of buildings and land can vary the duration and travel agents. Shields by way of sheltering in place can protect life |

| HAZARDS | MODE OF APPLICATION | DURATION OF THE HAZARD | EXTENSION OF EFFECTS: STATIC/DYNAMIC | MITIGATING AND EXACERBATING CONDITIONS |
|---|---|---|---|---|
| | | | | and property from the harmful effects. Failure to comply with fire codes and construction as well as lack of maintenance of fire protective containments can substantially increase damage due to the dispersion of hazardous materials. |

Sources: *Jane's Chem.-Bio Handbook; ** FEMA, Radiological Emergency Management Independent Study Course

The literature also provides two sub-categories of man-made hazards: social hazards and technological hazards. Social dangers are crime, civil disorder, terrorism and war. The dangers of a technological nature include: the dangers of an industrial nature such as spills and leaks of chemicals, among others, the collapse of structures and buildings (bridges, buildings, etc.), power outages or system crashes power supply, fire, hazardous materials (radioactive, chemical and biological) and transportation and aviation and rail accidents.

### 2.1.3 Identified Hazards Update

The updated inventory of identified hazards that affect the territory is determined by two main factors: the identification of technical information arising from scientific research or specialized studies and the incidence of official disaster declarations. During the term of the 2011 PEMPN, there was one official emergency declaration on August 22, 2011 (EM-3326) by the impact of the hurricane Irene to the Island, and two disaster declarations: the first in August 27, 2011 (DR-4017) to continue the recovery of the

severe rains, floods and landslides caused by Hurricane Irene, and the second in October 18, 2011 (DR-4040) by the effects of the tropical storm Maria in some of the municipalities of Puerto Rico. In addition, update data was obtained about Flood Caused by Tsunami and new data about: Wildfires, Evacuation Area by Tsunami, and Flood Caused by Climate Change.

## 2.2 Hazard Profile Affecting the Territory

### 2.2.1 Historical Documentation of Identified Hazards and Disaster Events

The profile descriptions of the natural hazards characteristics and their documentation in the territory of Puerto Rico allow identifying those hazards that are significant according to their frequency of occurrence and intensity. The profile description of each of these hazards is focused on describing the events that have available data to establish an indicator of the likelihood of future occurrences based on the frequency experienced in the past.

#### 2.2.1.1 Flooding

Puerto Rico through its history has been affected by floods and landslides. Globally, there is no other type of disaster that compares to flooding because of its high frequency and for being the main cause of the high numbers in loss of lives and property. The combination of weather events such as hurricanes and heavy rains with the location of properties (residential and commercial) in areas vulnerable to flooding or poor drainage areas, increases the incidence of these phenomena on the Island, and are the cause of many disasters.

It is a difficult task to pinpoint when and where floods occur, even with the high technology that exists to determine the potential for flooding of certain areas. This situation becomes more difficult if we consider floods classified as sudden. In the months of May to November, tropical waves and tropical cyclones and to a lesser occurrence troughs are responsible for the rain in Puerto Rico. The distribution of rain on the Island is not uniform. The Island has tropical rainforests in the Sierra de Luquillo and Cordillera Central, but semi-arid conditions prevailing in the south and southwest coasts. Average annual rainfall totals range from 30 inches in the southwest portion of the south coast up to 160 inches near the top of El Yunque. This is due mainly to the combination of the prevailing wind direction, the sea breeze, and topography. From May to November the greatest amounts of rain happen. It is in the summer where the greatest warming and where several high-frequency atmospheric phenomena develop in the tropics. Besides the weather there are other factors intervening to cause flooding and landslides; these are: population growth, development and construction in high risk areas such as valleys and coastal areas prone to flooding or landslides.

Historically, floods and hurricanes have caused major losses to life and property in Puerto Rico. The most severe floods that have occurred are associated with the passage of cyclonic systems and tropical waves. A brief description of them:

a. Hurricane San Ciriaco, 1899: This hurricane was one of the most shocking tragedies in terms of loss of life when 3,369 people died, mostly drowned.

Record of rainfall was recorded at 23 inches in 23 hours in the Municipality of Adjuntas.

b. Hurricane San Felipe, 1928: This hurricane is considered one of the most violent in its effects on Puerto Rico; causing flooding and no specified damages.

c. Hurricane San Ciprian, 1932: This hurricane happened a year after Hurricane San Nicolás (September 1931), it significantly affected agriculture and the economy was in recovery after the effects left by Hurricane San Nicolás. Hurricane San Ciprian left a toll of 225 dead people.

d. Hurricane Donna, 1960: This hurricane passed over 100 miles north of San Juan; however, heavy rains caused floods in which 107 people perished in the Municipality of Humacao.

e. Tropical Depression, 1970: This depression was stationary from October 5 to October 10, 1970. It produced widespread flooding that led to Presidential Disaster Declarations in 60 municipalities. The highest rainfall totals measured in Jayuya were 38.42 inches. There were 18 deaths and damage quantified over $65 million.

f. Tropical Storm Eloísa, 1975: This storm caused flooding and landslides that killed 34 people and 29 were reported missing. This time the damage was estimated at $125 million.

g. Hurricane David and Storm Federico, 1979: These events occurred on August 30 and September 4, 1979, respectively. Both events led to a Presidential Disaster Declaration in 72 municipalities and seven people were killed. The federal allocation for individual and public assistance totaled \$102 million.

h. Tropical Depression, 1985: In May 1985, there was another Presidential Disaster Declaration as a result of flooding caused by a tropical depression that later became Hurricane Gloria. Two people were dead and damage totaled \$37 million.

i. Tropical Wave - Mameyes Event, 1985: A tropical wave crossed the Island causing flooding in some areas, depositing up to 24 inches of rain in 24 hours. This record is the second largest rain after Hurricane San Ciriaco in Adjuntas which recorded 23 inches in 23 hours in 1899. The unusual rainfall recorded throughout the Island caused flooding, landslides and mudflows, interrupting the primary services, blocking roads, destroying bridges, damaging structures, runoff water deposited silt, gravel and debris on the roads, and public facilities threatening public safety. The works of flood control, drainage and irrigation facilities were blocked. The Water and Sewerage Authority and the Electricity Authority suffered significant damage in their systems. This tropical wave left 53 people dead from floods; the community of Mameyes was buried because of a landslide killing 127 people and a bridge collapsed killed 29 people. The flow of

water that eroded the bridge passed by the Municipality of Coamo destroying more than 600 homes. The water flow was higher than the expected recurrence of 100-year flood. About five bridges were destroyed, leaving many communities isolated. In addition, 17 people died in Ponce washed away by Las Batatas gully. There was a Presidential Disaster Declaration, 28 municipalities were eligible for Individual Assistance and 34 municipalities were eligible for Public Assistance, FEMA assistance totaled $ 263,600,000.

j. Hurricane Hugo, 1989: This hurricane was a Category 4. To the east and northeast of Puerto Rico there was an estimated storm surge of 4 to 6 feet in the vicinity of Fajardo and Ceiba. Higher storm surge totals were observed in Vieques and Culebra. There were about 10 inches of rain in 48 hours causing flooding in the northeastern part of the Island. There were heavy losses in livestock, agriculture and horticulture recorded; a total of 27 municipalities were eligible to receive federal aid. Damage was estimated at $2 billion. It is worth mentioning that during this hurricane, Carraízo Lake Dam posed a threat of flooding as a result of a power failure that prevented the floodgates to open and allow water discharge. The water level rose about five feet of the structure, reaching the engine room and damaging the pump motors of the dam. These engines pump water to the Sergio Cuevas Filtration Plant, which serves two-thirds of the San Juan Metropolitan Area and surrounding municipalities. Water service was restored nine days later.

k. Flooding of January 5-6, 1992: On January 5, 1992, a cold front accompanied by a trough in the upper levels of the atmosphere generated heavy rain and thunderstorms. This caused flash floods that killed 21 people, 18 of whom died in their cars traveling at night, three people missing, and more than $50 million in property damage. The deaths occurred mostly when people in their cars were swept away by the river or trying to cross rivers beyond their banks.

l. Hurricane Marilyn, 1995: The Islands of Vieques and Culebra were the hardest hit by this hurricane. Damage was estimated at 120 homes destroyed and another 829 with major and minor damage. The waste treatment plant located in the Municipality of Culebra was damaged causing the overflow of the lake which created a potential risk to the health of the community. The accumulation of debris was estimated at 4,000 cubic yards in Vieques and approximately 10,000 cubic yards in Culebra. Initially, estimated damage was $1.2 million for private residences and $9 million for municipal infrastructure. Twenty deaths and eight injuries were attributed to this disaster. The President signed Disaster Declarations for 14 municipalities.

m. Hurricane Hortense, 1996: This hurricane was Category 1 with winds of 85 mph. It caused severe damage to public and private property. Total damage was estimated at $200 million. It was reported the death and disappearance of 20 people, most of them as a result of flooding. About

10,500 people were in shelters across the Island. Recorded rainfall data exceeded 20 inches in 24 hours. In the interior of the Island rainfall exceeded the expected levels of a 100-year storm. Large tracts of land to the north, east and southeast of Puerto Rico remained under water. Many of the major rivers and its tributaries overflowed. The wind caused damage; however, the most significant damage was the effect of flooding. About 40 roadways were blocked by flooding and landslides and some bridges collapsed due to the speed of current flow or due to the accumulation of debris.

n. <u>Hurricane Georges, 1998</u>: This hurricane left a trail of damage as a result of high winds, rains, floods, mudslides and surges. The greatest accumulation of rain occurred in the central mountainous interior causing all rivers to overflow their banks, some of which set record discharges and many created new channels. The storm surge values were estimated at about 10 feet high in the town of Fajardo. Many parts of the West Coast experienced severe erosion of the beaches. The 78 municipalities were affected: 3.6 million people without drinking water, 600,000 people without phone service, 100% of the electrical system interrupted, 31,000 homeless, 100,000 houses damaged or destroyed, 40 bridges and miles of roads damaged or blocked, 2,500,000 cubic yards of rubble, 95% of the total loss of banana crop, 70% loss of total coffee harvest, and 60% loss of poultry production. The number of refugees rose to 28,000 in 420 shelters

spread throughout the Island. Puerto Rico economic impact of the damage caused by Hurricane Georges was estimated at $2 billion.

o. Flooding in November 2003: November 12 to 14, 2003 a trough caused heavy rains in the country for three consecutive days affecting the region south of the country. Total damages were estimated at $4.3 million. The roads affected were PR-10 from Adjuntas to Ponce, PR-52 at Cayey, and PR-172 that connects Caguas to Cidra. In the town of Moca a woman died after falling off a cliff in her car. Two men died trying to walk across flooded bridges in the municipalities of Aibonito and Ciales. Three bridges collapsed and six others were damaged. A total of 856 people had to be sheltered, 40 percent of the public school system was closed, twenty roads were impassable, 138,174 people were left without drinking water and 12,627 families were left without electricity. Hundred percent of crops were damaged, as well as starchy foods and coffee. In the Valle of Lajas many cattle drowned. The Rio Grande of Añasco came out of its banks causing loss of banana crop. President George Bush issued a Presidential Disaster Declaration covering 21 municipalities, which qualified for Public Assistance and Individual Assistance.

p. November 10, 2005: There was a new Presidential Emergency Declaration in Puerto Rico due to severe storms causing landslides and floods across the island. The most affected municipalities were: Adjuntas, Aibonito, Cayey, Guayanilla, Jayuya, Juana Diaz, Lares, Maricao, Orocovis,

Penuelas, Ponce, Salinas, Santa Isabel, Utuado, Villalba, Yabucoa and Yauco. Recovery assistance number provided by FEMA was 1613.

q. October 1, 2008: Presidential Disaster Declaration (DR-1798) due to severe storms and flooding beginning on September 21, 2008 to October 3, 2008. The most affected municipalities were: Guayama, Humacao, Maunabo, Patillas, Ponce, Salinas, Santa Isabel, and Yabucoa. The total number of residences impacted was 2,025 and the total of individual assistance cost estimate was $43,214,214.

r. June 24, 2010: Presidential Disaster Declaration (DR-1919) due to severe storms and flooding during the period of May 26 to 31, 2010. Ten municipalities were affected: Arecibo, Barranquitas, Coamo, Corozal, Dorado, Naranjito, Orocovis, Utuado, Vega Alta, and Vega Baja. The total public assistance cost estimate was of $6,074,262. This declaration also made Hazard Mitigation Grant Program assistance requested by the Governor available for hazard mitigation measures in all municipalities within the Commonwealth.

s. October 26, 2010: Presidential Disaster Declaration (DR-1946) due to severe storms, flooding, mudslides, and landslides associated with Tropical Storm Otto during the period of October 4 to 8, 2010. The most affected municipalities were: Adjuntas, Aibonito, Añasco, Guánica, Guayama, Jayuya, Lares, Las Marías, Maricao, Mayagüez, Morovis, Orocovis, Patillas, Ponce, Sabana Grande, Salinas, San Germán, Utuado,

Villalba, Yabucoa, and Yauco. Until October, 2015 $20,410,591.51 have been obligated on public assistance subvention.

t. July 14, 2011: Presidential Disaster Declaration (DR-4004) due to severe storms, flooding, mudslides, and landslides during the period of May 20, 2011 to June 8, 2011. The most affected municipalities were: Añasco, Caguas, Camuy, Ciales, Hatillo, Las Piedras, Morovis, Orocovis, San Lorenzo, San Sebastián, Utuado, and Villalba. Until October, 2015 $7,568,025.40 have been obligated on public assistance subvention.

u. Hurricane Irene

- ✓ August 22, 2011: Emergency Declaration (EM-3326) due to effects caused (severe rain, flooding, and landslides) by Hurricane Irene during the period of June 21 to 24, 2011. The aftermath of Hurricane Irene through Puerto Rico caused an impact on infrastructure, housing, personal property, and vehicles in 22 municipalities: Humacao, Naguabo, Ceiba, Fajardo, Luquillo, Loiza, Carolina, Caguas, Cidra, Cayey, Comerio, Aguas Buenas, Canóvanas, Gurabo, Juncos, Maunabo, San Lorenzo, Yauco, Orocovis, Villalba, Ponce, and Peñuelas.
- ✓ August 27, 2011: Presidential Disaster Declaration (DR 4017) due to effects caused by Hurricane Irene during the period of June 21 to 24, 2011. The effects of Hurricane Irene included: severe rain, flooding, and landslides. The Disaster Declaration included individual

assistance for seven municipalities: Caguas, Canóvanas, Carolina, Cayey, Loíza, Luquillo y San Juan. Also included public assistance for local government and non-profit organizations in Aguas Buenas, Carolina, Cayey, Ceiba, Comerío, Juncos, Las Marías, Luquillo, Morovis, Naguabo, Orocovis, Utuado, Vega Baja, and Villalba. The total individual assistance cost estimate was $30,346,741 and the total public assistance cost estimate was $4,905,003, where the primary impact was on roads and bridges.

v. Tropical Storm Maria: Presidential Disaster Declaration (DR-4040) due to effects caused by Tropical Storm Maria during the period of September 8 to 14, 2011. The effects of Tropical Storm Maria, included: severe rain, flooding, and landslides. The Disaster Declaration included individual assistance for three municipalities: Yabucoa, Juana Díaz, and Naguabo. The total individual assistance cost estimate was $7,240,282.

After 2011, there have been no floods of magnitude in Puerto Rico, or any disaster declarations have been made.

#### 2.2.1.2 Landslides Caused by Heavy Rains

Although the physical cause of much of the landslides cannot be eliminated, geological research, responsible engineering practices, and proper regulation of land use reduce the hazards associated with landslides. Knowing the general characteristics of the collapses, remedial measures can be carried out to reduce the possibility of their occurrence. We must seek professional advice to assess

whether the property is exposed to landslides and thus design and implement measures to mitigate its impact.

A summary of some significant landslides events recorded in the history of Puerto Rico is presented below.

a. Tropical Storm Eloísa, 1975: This storm caused flooding and landslides, unspecified damages.

b. Tropical Wave - Mameyes Event, 1985: From October 4 to October 7, 1985 one of the most catastrophic events in recent decades in Puerto Rico and the United States history occurred, which led to a Presidential Disaster Declaration and federal allocation of $65 million. On this occasion a tropical wave crossed the Island causing flooding in some areas, dumping up to 24 inches of rain in 24 hours. There were 127 people killed by a landslide in the neighborhood of Mameyes located in the municipality of Ponce. This was a squatter community located on a steep slope, which experienced a massive rock release. The soil failed, in part, to the saturation of the ground caused by a leak from a water storage tank located at the top of the slope. This wiped out 100 homes that were literally buried under layers of earth and rocks. Another tragedy occurred during the night when the slab of a bridge collapsed on the road leading from San Juan to Ponce, on the stretch of Coamo due to soil erosion under one of the columns; about 29 people rushed down the bridge and died.

c. Rains in November 2003: Rains caused 21 municipalities to be declared disaster areas by Presidential Disaster Declaration. Twenty-six roads were impassable among them; PR-10 between Adjuntas and Ponce was blocked by a landslide of 1,300 cubic meters of mud. On Highway Luis A. Cayey Ferré detachment of a pipe blocked two lanes. A huge wall of 40 feet belonging to a housing project (Bairoa Wall) in the Municipality of Caguas collapsed in some areas, endangering the lives of more than a dozen families who lived behind it. A family in the town of Moca became homeless when their three-story house collapsed, the family came out unharmed. The rains caused the ground to give way and split some of the columns, the land deposited outside the residence that gave way consisted of 19 feet of landfill and rough soil. Several landslides left some communities in the municipality of Utuado isolated; in the development Barriada Nueva 30 houses were in danger of collapsing as the river undermined the land of the local road which faces the residences. In the Monte Verde development, in the municipality of Manati, three families lost their homes in a sinkhole and six other houses sank exposing the vents of other sinkholes. The construction of this development took place between hummocks and a total of eight sinkholes that were fenced by the developer to isolate them from the 500 homes built.

d. September 17, 2004: By Presidential Disaster Declaration number 1552, FEMA has provided financing for recovery for the effects of Tropical Storm Jeanne, which caused multiple landslides events in virtually the

entire Island. A total of 72 municipalities received assistance because of this event.

e. November 10, 2005: Presidential Emergency Declaration because of severe storms causing landslides and floods across the Island. The most affected municipalities were: Adjuntas, Aibonito, Cayey, Guayanilla, Jayuya, Juana Diaz, Lares, Maricao, Orocovis, Penuelas, Ponce, Salinas, Santa Isabel, Utuado, Villalba, Yabucoa and Yauco. Recovery assistance provided by FEMA was number 1613.

f. March and April 2008: Rainfall occurred during the months of March and April 2008 causing landslides. The effects of these events impacted the community of Carruzo de Carolina, the community Cerca del Cielo (Close to the Sky) in Ponce, and the community of Unibon in Morovis. The combination of geological, climatological and the inappropriate construction and development practices in urbanized areas were the main causes for these landslides.

g. October 26, 2010: Presidential Disaster Declaration (DR-1946) due to severe storms, flooding, mudslides, and landslides associated with Tropical Storm Otto during the period of October 4 to 8, 2010. The most affected municipalities were: Adjuntas, Aibonito, Añasco, Guánica, Guayama, Jayuya, Lares, Las Marías, Maricao, Mayagüez, Morovis, Orocovis, Patillas, Ponce, Sabana Grande, Salinas, San Germán, Utuado,

Villalba, Yabucoa, and Yauco. Until October, 2015 $20,410,591.51 have been obligated on public assistance subvention.

h. July 14, 2011: Presidential Disaster Declaration (DR-4004) due to severe storms, flooding, mudslides, and landslides during the period of May 20, 2011 to June 8, 2011. The most affected municipalities were: Añasco, Caguas, Camuy, Ciales, Hatillo, Las Piedras, Morovis, Orocovis, San Lorenzo, San Sebastián, Utuado, and Villalba. Until October, 2015 $7,568,025.40 have been obligated on public assistance subvention.

After 2011, there have been no landslides of magnitude in Puerto Rico, or disaster declarations have been made.

### 2.2.1.3 Winds (Tropical Cyclones)

Hurricanes are one of the most common natural hazards in Puerto Rico. The damage to buildings and infrastructure can be caused either by wind or debris that can act as missiles. Tropical cyclones are phenomena that generate spontaneously and their movement and development are unpredictable. However, during the months of May to November tropical waves and tropical cyclones and troughs occur less frequently. Hurricanes, which are the most destructive weather phenomena, have led to significant events mentioned below.

a. Hurricane San Felipe, 1928: This hurricane is considered one of the largest cyclones occurred in the North Atlantic. Maximum sustained winds were 160 mph (Category 5), with gusts of 200 mph. It caused extensive damage

on the estates and property, 312 people died, 83,000 people without shelter and it caused $50 million in losses.

b. Hurricane Hugo, 1989: This was a Category 4 hurricane, passed through San Juan with sustained winds of 125 mph. As a result of the damage caused by strong winds, a Presidential Disaster Declaration was issued in which 57 municipalities were declared eligible for Public Assistance and Individual Assistance. There was one death and damage was estimated at $1 billion.

c. Hurricane Marilyn, 1995: On September 15, early in the morning, the center of the hurricane passed 45 miles east-northeast of San Juan with maximum sustained winds of 110 mph, as he advanced in its movement it became a Category 3 hurricane.

d. Hurricane Hortense, 1996: The damage to houses by high winds, were classified moderate to extensive. Agriculture suffered severe damage, particularly the mountainous area. Other damages associated with winds were falling trees, falling utility poles and telephone poles. Also, the effect of wind caused structural damage to some 4,000 homes. A Presidential Disaster Declaration was issued covering 67 municipalities.

e. Hurricane Georges, 1998: This hurricane caused that extensive agricultural areas were defoliated as a result of the hurricane winds of 110 mph, about 4.5 million birds died representing 60 percent of poultry

production, and a workforce of 36,000 agricultural jobs were affected. Damage to roads in the country was estimated at $45 million due to heavy rains and strong winds. Forests were impacted when the winds defoliated and uprooted trees causing an accumulation of vegetative debris, mainly in urban areas. The forest areas are classified as critical to the recovery of native and migratory bird species, and for the quality, scenic beauty and effectiveness of the Puerto Rico plant infrastructure also suffered extensive damage. The United States Army Corps of Engineers indicated that the hurricane caused a total of approximately 2.5 million cubic yards of vegetative debris (trees, branches and leaves) equivalent to three 50-story buildings. An estimated 20,000 homes were destroyed, 38,000 homes suffered major damage, 63,000 homes reported minor damage, and 48,500 were affected. Two days after the Hurricane, 31,500 people were in shelters. Puerto Rico's government estimated the hurricane's economic impact to businesses at $528 million. The government spent $ 371,500 in Public Assistance to repair damage to its infrastructure. The 78 municipalities suffered significant damage. The Presidential Disaster Declaration for 78 municipalities included all categories of disaster relief. It is the first time that all the municipalities of Puerto Rico are included in only one Presidential Disaster Declaration.

f. Tropical Storm Otto: The indirect effects of Tropical Storm Otto in October 4 to October 8, 2010 caused flooding and mudslides, a Presidential Disaster Declaration (DR-1946) was issued covering 25

municipalities. The municipalities included in the declaration were: Adjuntas, Aibonito, Anasco, Cayey, Ciales, Corozal, Guanica, Guayama, Jayuya, Lares, Las Marias, Maricao, Mayaguez, Morovis, Orocovis, Patillas, Ponce, Sabana Grande, Salinas, San Germán, San Lorenzo, Utuado, Villalba, Yabucoa and Yauco. Until October, 2015 $20,410,591.51 have been obligated on public assistance subvention.

g. Hurricane Irene

- ✓ August 22, 2011: Emergency Declaration (EM-3326) due to effects caused (severe rain, flooding, and landslides) by Hurricane Irene during the period of June 21 to 24, 2011. The Aftermath of Hurricane Irene through Puerto Rico were the impact on infrastructure, housing, personal property, and vehicles in 22 municipalities: Humacao, Naguabo, Ceiba, Fajardo, Luquillo, Loiza, Carolina, Caguas, Cidra, Cayey, Comerio, Aguas Buenas, Canóvanas, Gurabo, Juncos, Maunabo, San Lorenzo, Yauco, Orocovis, Villalba, Ponce, and Peñuelas.
- ✓ August 27, 2011: Presidential Disaster Declaration (DR 4017) due to effects caused by Hurricane Irene during the period of June 21 to 24, 2011. The effects of Hurricane Irene included: severe rain, flooding, and landslides. The Disaster Declaration included individual assistance for seven municipalities: Caguas, Canóvanas, Carolina, Cayey, Loíza, Luquillo y San Juan. Also included public assistance for local government and non-profit organizations in Aguas Buenas,

Carolina, Cayey, Ceiba, Comerío, Juncos, Las Marías, Luquillo, Morovis, Naguabo, Orocovis, Utuado, Vega Baja, and Villalba. The total individual assistance cost estimate was $30,346,741 and the total public assistance cost estimate was $4,905,003, where the primary impact was on roads and bridges.

h. Tropical Storm Maria: Presidential Disaster Declaration (DR-4040) due to effects caused by Tropical Storm Maria during the period of September 8 to 14, 2011. The effects of Tropical Storm Maria, included: severe rain, flooding, and landslides. The Disaster Declaration included individual assistance for three municipalities: Yabucoa, Juana Díaz, and Naguabo. The total individual assistance cost estimate was $7,240,282.

After 2011, there have been no tropical phenomena of magnitude in Puerto Rico, or disaster declarations have been made.

### 2.2.1.4 Earthquake

The history of earthquake damage in Puerto Rico dates back to 1617 and most recently as July 29, 1943. Science is not yet advanced enough to predict when an earthquake happens. Every day there is an average of three to four earthquakes in Puerto Rico. Most of these are imperceptible to humans, only seismographs, which are instruments used to measure them, record them. Based on frequency statistics and recurrence of these phenomena, it is estimated that earthquakes have occurred on the Island with a recurrence of every 57-117 years (one or two per century). The last strong earthquake was in 1918, this is an indicator that there is a

significant possibility that we could feel another strong tremor of equal magnitude with destructive effects in the next 40 years. However, it should be noted that each of these events are generated along a different fault, therefore, based on these events alone there cannot make a prediction on occurrence. In Puerto Rico, vulnerability studies have shown a probability of 33 to 50 percent of vigorous shaking (Intensity VII or more on the Modified Mercalli Scale) for different parts of the Island for a period of 50 years.

The north Trench of Puerto Rico, 60 km from San Juan, is the source of the Metropolitan Area earthquake, with a potential to produce earthquakes of magnitudes between 8 and 8.25 on the Richter Scale. Considering the likely magnitude and the analysis of Dr. Molinelli (1987) the intensity of Modified Mercalli Scale VIII should be an estimate of potential damage. The most important geological hazards in the metropolitan area would be the seismic wave amplification, liquefaction, and landslides. In the metropolitan area the areas of greatest vulnerability to seismic amplification are the lands bordering the Bay of San Juan, Caño Martin Peña, Laguna San José, as well as deep alluvial deposits of the Rio Bayamon, Rio Piedras and Rio Grande Loiza. These areas are exposed to strong shaking and ground failure. On these areas, an important part of the energy infrastructure, water, roads, airports, and areas with high density commercial and residential buildings have been established.

In the mountainous area, the main danger is posed by landslides, as almost three quarters of the surface of Puerto Rico is mountainous. This implies that a strong

earthquake could be accompanied by numerous landslides, especially if it occurs after a prolonged period of rain that has saturated the land.

The history of earthquakes recorded in Puerto Rico is as follows:

a. September 8, 1615: An earthquake in the Dominican Republic caused damage in Puerto Rico.

b. August 15, 1670: There was a strong earthquake of unknown magnitude that significantly affected the region of San Germán.

c. Year 1717: An earthquake caused the destruction of the Churches of Arecibo and San Germán.

d. August 30, 1740: An earthquake of Intensity VII (Modified Mercalli Scale) destroyed the Church of Guadalupe in Ponce.

e. May 2, 1787: It was probably the strongest earthquake that struck Puerto Rico since the early colonization. It was strongly felt throughout the Island and may have reached a magnitude of 8.0 degrees on the Richter Scale. Its epicenter was possibly the North, in the Puerto Rico Trench. This earthquake demolished the Arecibo church along with the Rosario and Concepción Chapels, churches in Bayamon, Toa Baja and Mayaguez were also damaged. It also caused considerable damage in the San Felipe del Morro and San Cristobal, where water tanks, walls and guard houses cracked. Except for the southern area, the whole Island was damaged.

f. April 16, 1844: An earthquake of intensity VII-VIII (Modified Mercalli Scale) destroyed several buildings and homes, municipalities affected are not specified.

g. November 28, 1846: An earthquake of unknown intensity was felt throughout the Island; little damage to the northern area was reported.

h. November 18, 1867: Twenty days after the Island had been devastated by Hurricane Narciso, there was a strong earthquake with a magnitude of about 7.5 degrees on the Richter scale. Its epicenter was located in the Anegada Passage between Puerto Rico and the Island of Santa Cruz. The earthquake caused a tsunami that came about 150 meters (490 feet) inland in low-lying coastal parts of the municipality of Yabucoa. The earthquake caused damage to many buildings in the Island, especially in the East.

i. December 8 to 9, 1875: Earthquake damage was reported in Arecibo and Ponce, the intensity was not specified.

j. September 27, 1906: An earthquake, intensity not specified but only described as a great damage on the north coast.

k. October 11, 1918: The epicenter of this earthquake was located northeast of Aguadilla in the Mona Canyon. The earthquake had a magnitude of 7.5 degrees on the Richter scale and was accompanied by a tidal wave or tsunami. The damage was concentrated in the area west of the Island as this is the area is closest to the epicenter. The earthquake killed

approximately 116 people and caused over $4 million dollars in losses. Many houses, factories, public buildings, chimneys of the sugar industry, bridges and other buildings were severely damaged.

l. July 29, 1943: An earthquake of magnitude 7.3 on the Richter scale was felt in the northeastern part of the Island, damages not specified.

m. August 4, 1946: An earthquake in the Dominican Republic caused damage to the western part of Puerto Rico.

In recent history, Puerto Rico has not been affected by earthquakes, although there have been seismic activities which magnitude can be perceived by people but don't make damage to structures.

### 2.2.1.5 Drought

The negative impact of drought is based on a combination of frequency, severity and spatial extent (physical nature of the drought) and the extent to which activities may affect the population because of the same. The degree of vulnerability of a particular region of the country depends on both environmental and social elements, and their magnitude depends on the ability to anticipate situations of drought, the ability to manage its impacts and the ability to withstand and recover from drought.[11] The climatic and topographic conditions are the main factors for drought conditions in Puerto Rico, being the Southeast areas the most affected.

[11] Reference: http://www.drought.unl.edu/risk/impactvulnerability.htm

The National Drought Mitigation Center (NDMC) from the University of Nebraska, in collaboration with the Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA) keep statistics on the levels of possible drought recorded in the United States, including Puerto Rico. The data are grouped into the following categories: D0-Abnormally Dry, D1-Moderate Drought, D2-Severe Drought, D3-Extreme Drought, and D4-Exceptional Drought.

Puerto Rico does not experienced extreme drought conditions with relative frequency. However, there have been important events that have negatively impacted agriculture and have required drastic measures such as water rationing and the introduction of emergency measures such as the distribution of drinking water to affected communities. According to data provided by FEMA, there have been two emergency situations for which federal assistance was needed. The two drought events are:

a. May 26, 1964: Presidential Disaster Declaration Number 170 due to extreme drought conditions.

b. August 29, 1974: Presidential Emergency Declaration Number 3002 due to drought impacts.

In addition to these events, Puerto Rico has experienced two important drought periods that haven't had emergency declarations or presidential disasters. These are:

a. Drought 1994: According with the data, Puerto Rico began experiencing a decrease of 35% in the normal amount of rain since August 1993. The decrease of rain had its fluctuations but it sharpened during the period of April to July, 1994, where a 56% of normal rain was registered for the Central East region where the basins of the Rio Grande de Loíza (Represa Carraízo) and Río La Plata (Represa La Plata) are found. This drought caused an impact to 55% of Puerto Rico and it was necessary to implement the rationing of the water service in 29 municipalities. The rationing of water began on April 5, 1994 and it ended in September, 1994 because of heavy rains that increase the basins levels. This drought had a negative impact in the economy of Puerto Rico, particularly in agriculture with a gross income loss estimate of $93.9 million.

b. Drought 2015: This drought started on March, 2015 when the AAA gave its first warning on the necessity of saving water since the basins were decreasing their levels. On May, the *U.S. Drought Monitor*, classified 12 municipalities under Moderate Drought and 40 municipalities were declared as Abnormally Dry. This caused a negative impact in agriculture, rivers, basins, and wells. To address the situation the AAA developed a Rationing Plan that had three phases: Phase 1: water in alternate days, Phase 2: one day with water and two without, and Phase 3: one day with water and three without.

The following orders were established because of the 2015 Drought:

- State Emergency Executive Order (OE-2015-011): Order to declare an emergency state concerning the use of water and establish an interagency action plan.

- Price Freezing Order 2015-03: Order to freeze prices of all products or material needed to mitigate the effects of the drought.

- Administrative Order (OA-2015-02): Order to regulate the use of drinking water in 48 municipalities on certain activities during the drought. Some of the regulated activities were: to water the plants between 8:00 AM to 6:00 PM., wash cars, and fill pools or fountains.

The violation of this orders lead to administrative penalties of $250.00 in residential activities and $750.00 in commercial, industrial or governmental activities. The rationing plan ended on October 25, 2015 because heavy rains were reported and the basins reached its levels. In Appendix 2-A are included the establish ordinance by the 2015 Drought and provided data by the *U.S. Drought Monitor*.

### 2.2.1.6 Tsunamis

During an earthquake, as well as ground vibrations and expansion of seismic waves, landslides or mudslides, tidal waves or tsunamis and liquefaction can occur. The seismic waves are amplified in soft thick ground. These areas

generally include the floodplains and areas where gaps have been filled, streams, swamps and mangroves. During an earthquake, these places shake harder and longer, for this reason they suffer more damage.

Puerto Rico's seismic history and throughout the Caribbean region provides valid data to consider that tsunamis can occur again. Coastal areas are, in general, at higher risk because they are closer to the submarine fault, have greater exposure to the occurrence of tsunamis; the seismic waves are more amplified and have greater potential for liquefaction in sandy coast areas. Recorded seismic activity indicates that the probability of the Municipality of San Juan of being affected by an earthquake or tsunami is low. The severity level of the wave entering the coastal zone is between 120 to 150 meters in the low places.

Tsunamis events in the history of Puerto Rico are as follows:

a. November 18, 1867: An earthquake generated a tsunami that struck Southeast Puerto Rico, which was preceded by the sea retreating150 meters. Then the sea came inland the same distance. The sea came up several feet in some places along the coast, penetrated nearly 150 meters in the lower parts of the coast in the Municipality of Yabucoa.

b. October 11, 1918: An earthquake in Puerto Rico generated a tsunami wave which reached six feet in northeastern Puerto Rico, but was almost undetectable in San Juan. This tsunami occurred minutes after the earthquake. Before the tsunami the ocean receded hundreds of feet and then came inland more than 120 meters in some lower areas. In Aguadilla

it killed 40 people and destroyed nearly 300 homes that were located near the beach. In total 116 people died and property damage exceeded $4 million.

c. August 8, 1946: There was an earthquake in Mayaguez and Aguadilla of magnitude 7.4 on the Richter scale, damages are not specified.

In recent history, Puerto Rico has not been affected by Tsunamis.

#### 2.2.1.7 Climate Change

Direct effects of climate change in Puerto Rico have not been scientifically documented, therefore it is not possible to determine the effect it has had on weather conditions and atmospheric events that have been occurring in recent years. There is also limited accuracy of analysis of the future effects of this worldwide phenomenon. To address the limitation of information, it is important to promote specialized scientific studies that provide more information about local impacts and provide more attention to the potential impacts of hazards discussed above, because their magnitude could increase the effect of global warming. The geographical situation of Puerto Rico and its singular topography, require to maintain a constant monitoring on the outcome of the research being conducted on this subject to plan and take preventive measures if needed. This includes determining how climate change will affect the structures and infrastructures of Puerto Rico, particularly those located on the coast.

To establish public policy over Climate Change Mitigation, Puerto Rico states the Law No. 246 of August 10, 2008. The Law 246, has the purpose of identifying

and promoting actions to reduce the factors that speed up the effects of climate change, like greenhouse gases.

#### 2.2.1.8 Hazards Caused by Humans

Considering the multitude of hazards that may be caused by accidental or voluntary human activity, there is limited availability of official data that allow detailed evaluation of events that have been experienced in the past through the territory. Since the tragic events of September 11, 2001 in New York, the interest of government agencies engaged in the formulation of mitigation strategies has turned to the study and prevention of terrorist activities.

In the case of Puerto Rico, the concept of terrorism carries political connotations and different points of view could define these events differently. If we take the official statistics of the Federal Bureau of Investigations (FBI), the incidence of terrorist nature activities in Puerto Rico are relatively high. According to a report published in 1987, during the period of 1983 to 1987, there were 82 incidents of terrorism in the United States, of which 34 (41.5%) occurred in Puerto Rico.[12] According to the report, of the six cities with the highest incidence of terrorist attacks in the United States, two were in Puerto Rico, Mayaguez and Rio Piedras. The most important events cited were:

a. <u>October 17 to 18 1979</u>: Bombs in various U.S. government facilities of throughout the Island.

12 U. S. Department of Justice, Federal Bureau of Investigation, *Terrorism in the United States*, National Memorial Institute for the Prevention of Terrorism in Oklahoma City, 1987.

b. January 12, 1981: Bomb destructions of nine A-7 aircraft and damaged two other properties of the Puerto Rico National Guard facilities at Muñiz Base.

c. November 11 and 27, 1981: Bombs on substations owned by the Puerto Rico Electric Power Authority with losses totaling $4 million.

d. May 25, 1987: Explosions in four locations across the Island (Western Mayaguez Federal Bank, New York Department Store in Caguas, Ponce U.S. Customs Service and U.S. Postal Service in Aibonito).

In recent decades there has not been any record of terrorist events in the territory. On the other hand, as far as emergency situations created by random or accidental causes, there are two Presidential Emergency Declarations.

a. November 21, 1996: Presidential Emergency Declaration (EM-3124) due to gas explosion by propane leak in a building located in Rio Piedras, in which there were multiple injuries to life and property. The explosion left a toll of 33 dead and 69 wounded.

b. October 24, 2009: Presidential Emergency Declaration (EM-3306) due to explosions and fires in fuel storage facilities of the company CAPECO in the town of Cataño, during the period of October 23 to 26, 2009. This emergency declaration included the municipalities of Bayamon, Cataño, Guaynabo, San Juan, and Toa Baja.

## 2.2.2 Geographic Analysis of Possible Impact by Identified Hazards

As part of the PEMPN update process, and as discussed in methodology section, the databases and maps of the state and municipal hazard assessment, conducted in 2011 PEMPN, were updated. This resulted in the identification of data sources, data collection, and generation of new maps. The GIS analysis tools allowed to update the changes arising on natural hazards and provided technical information to municipalities for the development and updating of mitigation plans

A map was produced for each natural hazard which had geo-referenced databases, showing an increased vulnerability to the occurrence of the hazard. Each map uses different data sources and different approaches to its composition in the geographical information system, depending on the source or entity that developed it. The risk level of the territory can be observed on the maps of the hazards, on a scale of 5 levels (Very Low to Very High).

### 2.2.2.1 Earthquakes

For the analysis of this hazard, the layer of information created in the 2011 PEMPN was used. The map used is based on the 1994 seismic hazard map developed by Earth Science Consultants. The study used as the basis provided estimates of earthquake intensity (expressed in terms of Peak Ground Acceleration (PGA), 50 -, 100 -, 250 -, 1,000 - year-revival), for general conditions of bedrock and soils of Puerto Rico.

The Map 2-1: *Earthquakes*, presented below, was generated for a 100 year earthquake and the analysis showed that the 10 municipalities with most affected population, in the levels high and very high risk, are:

| **RANK OF POTENTIALLY AFFECTED POPULATION<br>HAZARD: *Earthquakes*** | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| San Juan | 397,814 | 252,878 | 63.57% | 1 |
| Carolina | 176,765 | 117,512 | 66.48% | 2 |
| Caguas | 142,888 | 85,008 | 59.49% | 3 |
| Toa Baja | 89,594 | 75,217 | 83.95% | 4 |
| Arecibo | 96,436 | 65,066 | 67.47% | 5 |
| Aguadilla | 60,942 | 53,400 | 87.62% | 6 |
| Bayamón | 208,114 | 52,233 | 25.10% | 7 |
| Vega Baja | 59,658 | 40,653 | 68.14% | 8 |
| Mayagüez | 89,071 | 40,194 | 45.13% | 9 |
| Isabela | 45,629 | 35,674 | 78.18% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-1.

Earthquakes can cause other effects or significant risks, such as liquefaction, landslides, and seismic waves. These induced risks by earthquake effects are presented below.

### 2.2.2.2 Liquefaction Caused by Earthquakes

For hazard analysis by liquefying, was used the layer of geographic information created in 2002 as part of the UMET[13.] Study. This five categories were grouped based on probabilities calculated using methods consistent with the HAZUS methodology (FEMA, 1999). The areas susceptible to liquefaction are shown in the Map 2-2. The areas of high and very high susceptibility coincide with the areas of deep alluvial deposits, unconsolidated, and associated to a high water table. These areas are most commonly found in flood plains and on the northern coast of Puerto Rico. The 10 municipalities with most affected population by liquefaction, in the levels high and very high risk, are:

| **RANK OF POTENTIALLY AFFECTED POPULATION**<br>**HAZARD: *Liquefaction Caused by Earthquakes*** | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| San Juan | 397,814 | 92,330 | 23.21% | 1 |
| Carolina | 176,765 | 90,707 | 51.32% | 2 |
| Toa Baja | 89,594 | 61,875 | 69.06% | 3 |
| Mayagüez | 89,071 | 39,895 | 44.79% | 4 |
| Bayamón | 208,114 | 39,139 | 18.81% | 5 |
| Cataño | 28,145 | 27,949 | 99.31% | 6 |
| Loíza | 30,061 | 27,490 | 91.45% | 7 |
| Fajardo | 36,993 | 18,215 | 49.24% | 8 |
| Cabo Rojo | 50,909 | 15,669 | 30.78% | 9 |
| Añasco | 29,260 | 15,222 | 52.02% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-2.

13 Universidad Metropolitana, Escuela de Asuntos Ambientales, *Evaluación Integrada de Peligros Naturales para la isla de Puerto Rico*, Abril 3, 2002.

### 2.2.2.3 Landslides Caused by Earthquakes

To characterize the relative susceptibility of landslides induced by earthquakes in a region, the conditions of soil / geology, slope, soil water content and the history of outstanding performance should be assessed. According to these characteristics, a relative range of susceptibility to slippage (very low to very high) was assigned, using the classification system based on the HAZUS methodology (FEMA, 1999).

The probability used for landslides caused by earthquakes was as follows:

| PGA (g) | CATEGORIES LANDSLIDE SUSCEPTIBILITY | | | | |
|---|---|---|---|---|---|
| | **Very Low** | **Low** | **Moderate** | **High** | **Very High** |
| 0.50 | 1% | 5% | 15% | 25% | 30% |
| 0.45 | 0.0% | 5% | 15% | 25% | 30% |
| 0.40 | 0.0% | 5% | 15% | 25% | 30% |
| 0.35 | 0.0% | 5% | 15% | 25% | 30% |
| 0.30 | 0.0% | 5% | 15% | 25% | 30% |
| 0.25 | 0.0% | 0.0% | 15% | 25% | 30% |
| 0.20 | 0.0% | 0.0% | 15% | 25% | 30% |
| 0.15 | 0.0% | 0.0% | 0.0% | 25% | 30% |
| 0.10 | 0.0% | 0.0% | 0.0% | 0.0% | 30% |
| 0.05 | 0.0% | 0.0% | 0.0% | 0.0% | 30.0% |

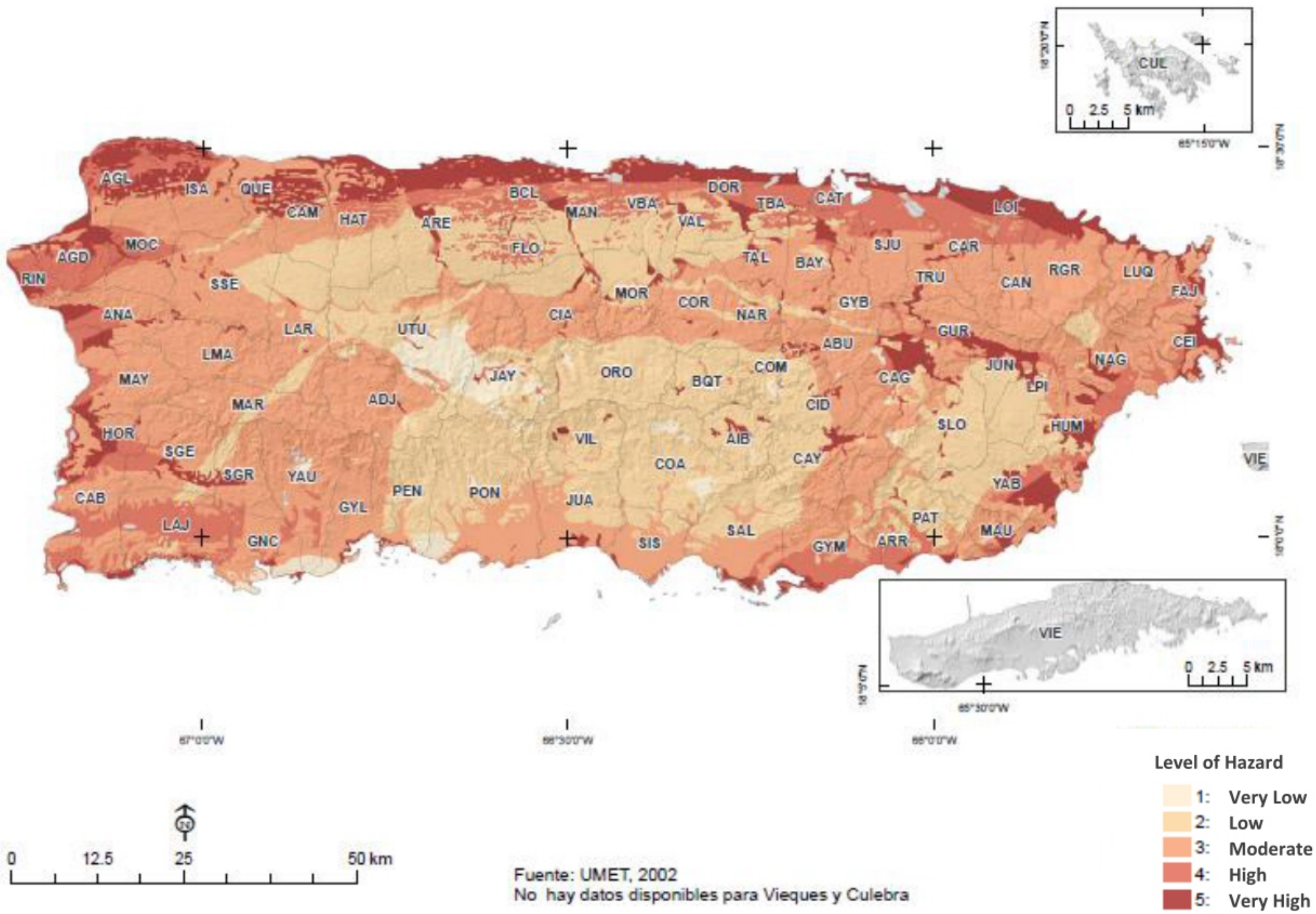
These and other necessary components were used by the UMET to create a geographic layer of landslides caused by earthquakes, as part of the study Natural Hazards Integrated Assessment for the Puerto Rico Island. Of the analysis was obtained that the 10 municipalities with most affected population by landslides, in the levels high and very high risk, are:

| **RANK OF POTENTIALLY AFFECTED POPULATION<br>HAZARD:** ***Landslide Caused by Earthquake*** | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk** ***Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| Aguadilla | 60,942 | 27,717 | 45.48% | 1 |
| Isabela | 45,629 | 21,621 | 47.38% | 2 |
| Hatillo | 41,952 | 3,386 | 8.07% | 3 |
| Cayey | 48,114 | 2,846 | 5.91% | 4 |
| Utuado | 33,148 | 2,839 | 8.56% | 5 |
| Cidra | 43,478 | 2,809 | 6.46% | 6 |
| Yabucoa | 37,938 | 2,726 | 7.19% | 7 |
| Aguada | 41,961 | 2,726 | 6.50% | 8 |
| Arecibo | 96,436 | 2,566 | 2.66% | 9 |
| Moca | 40,108 | 2,364 | 5.89% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-3.

The areas susceptible to landslides induced by earthquakes are shown in the Map 2-3 and in the Map 2-4 is shown the potential impact of seismic waves induced by an earthquake in Puerto Rico.

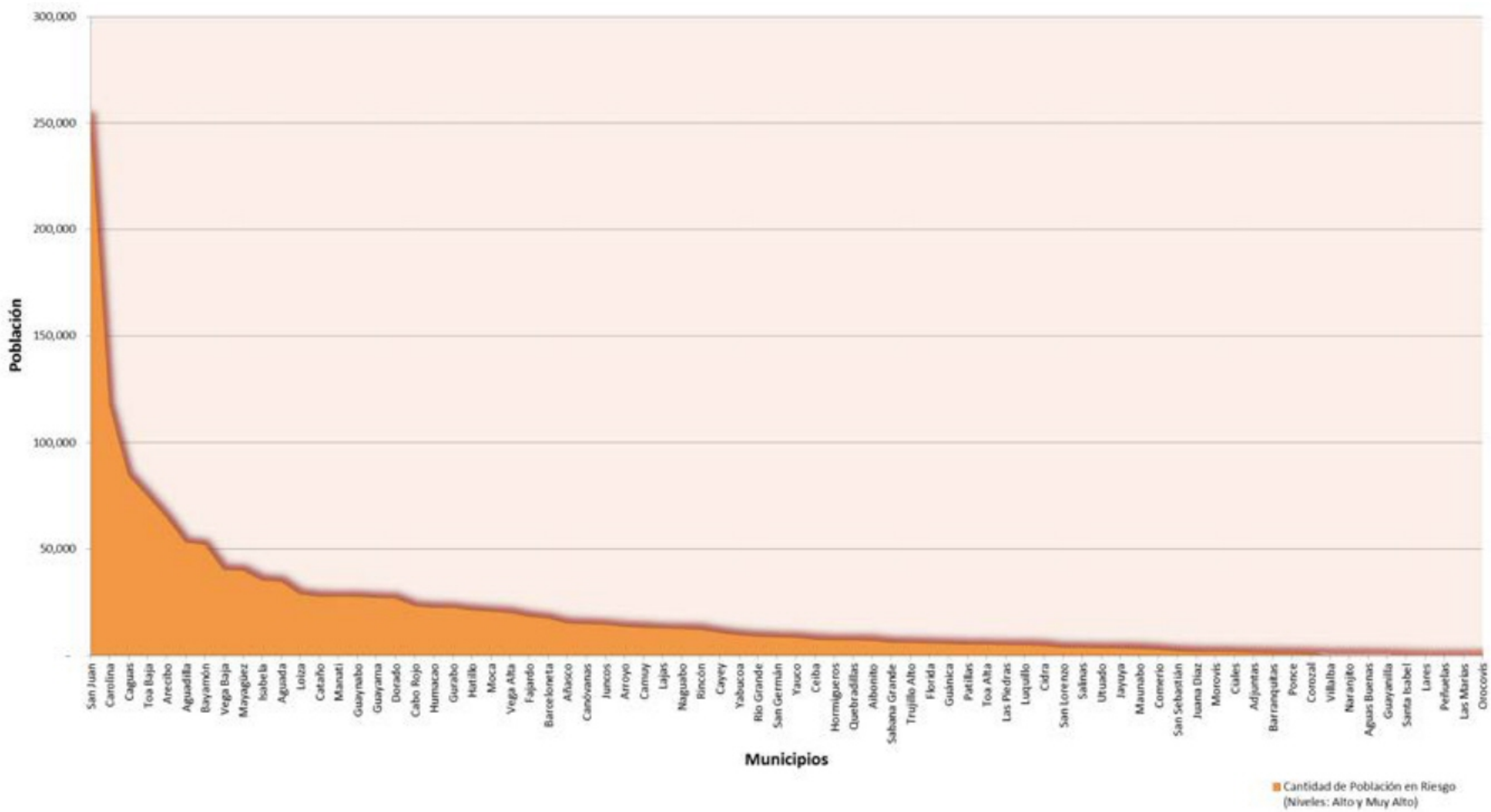
## Map 2-1
## HAZARD: EARTHQUAKES



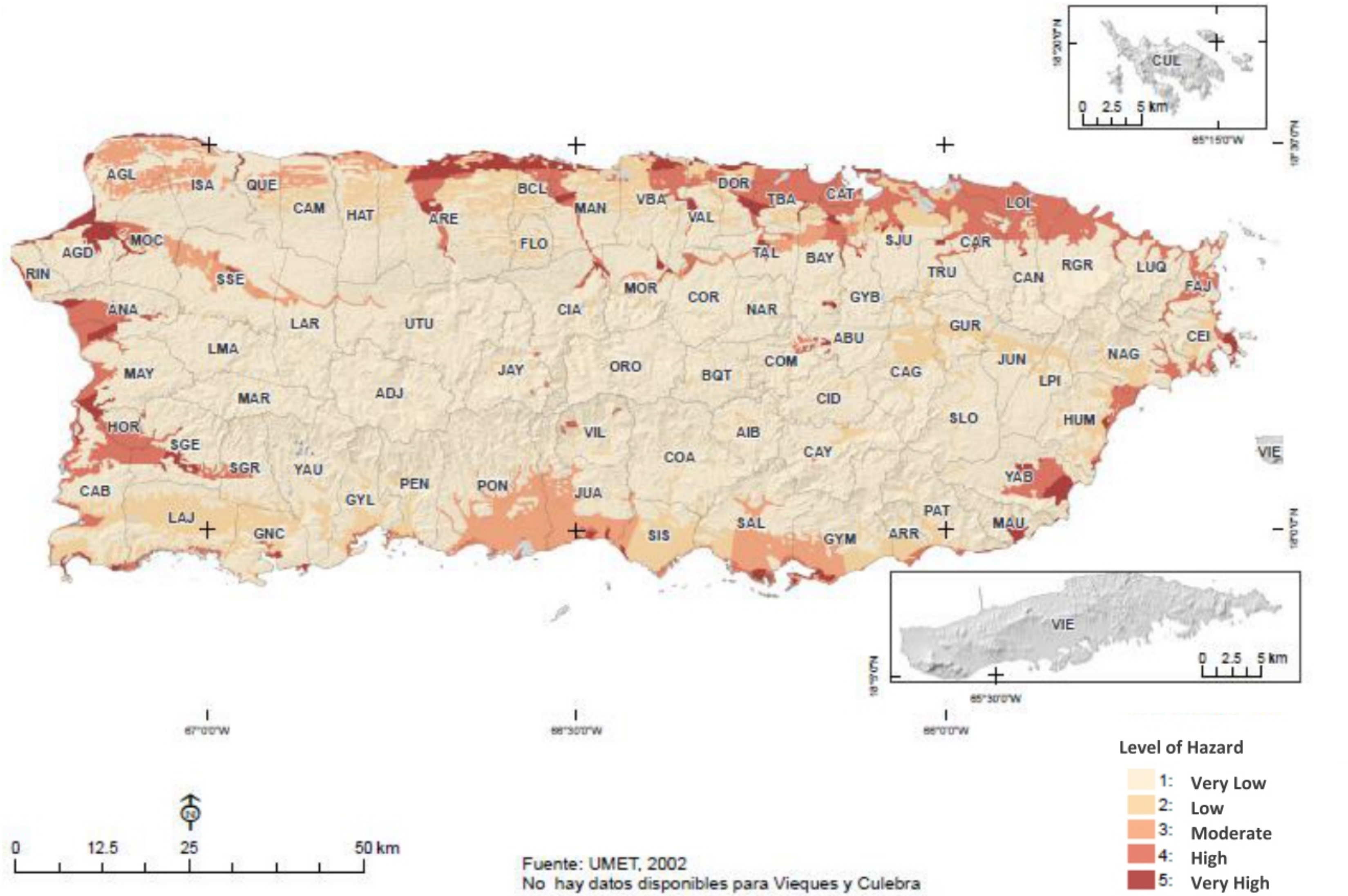
## Graph 2-1

# HAZARD: EARTHQUAKES

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



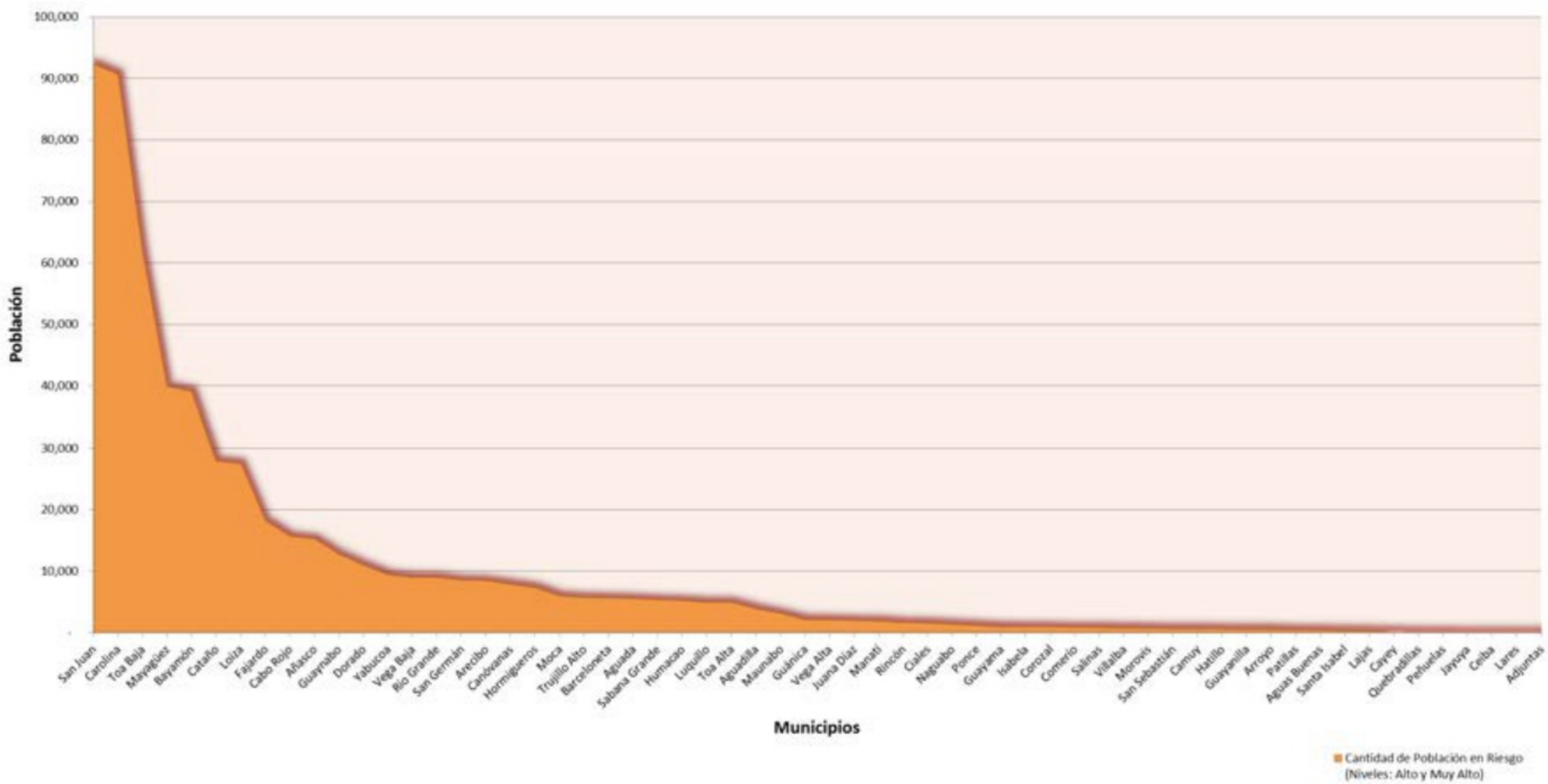
## Map 2-2
# HAZARD: LIQUEFACTION CAUSED BY EARTHQUAKES



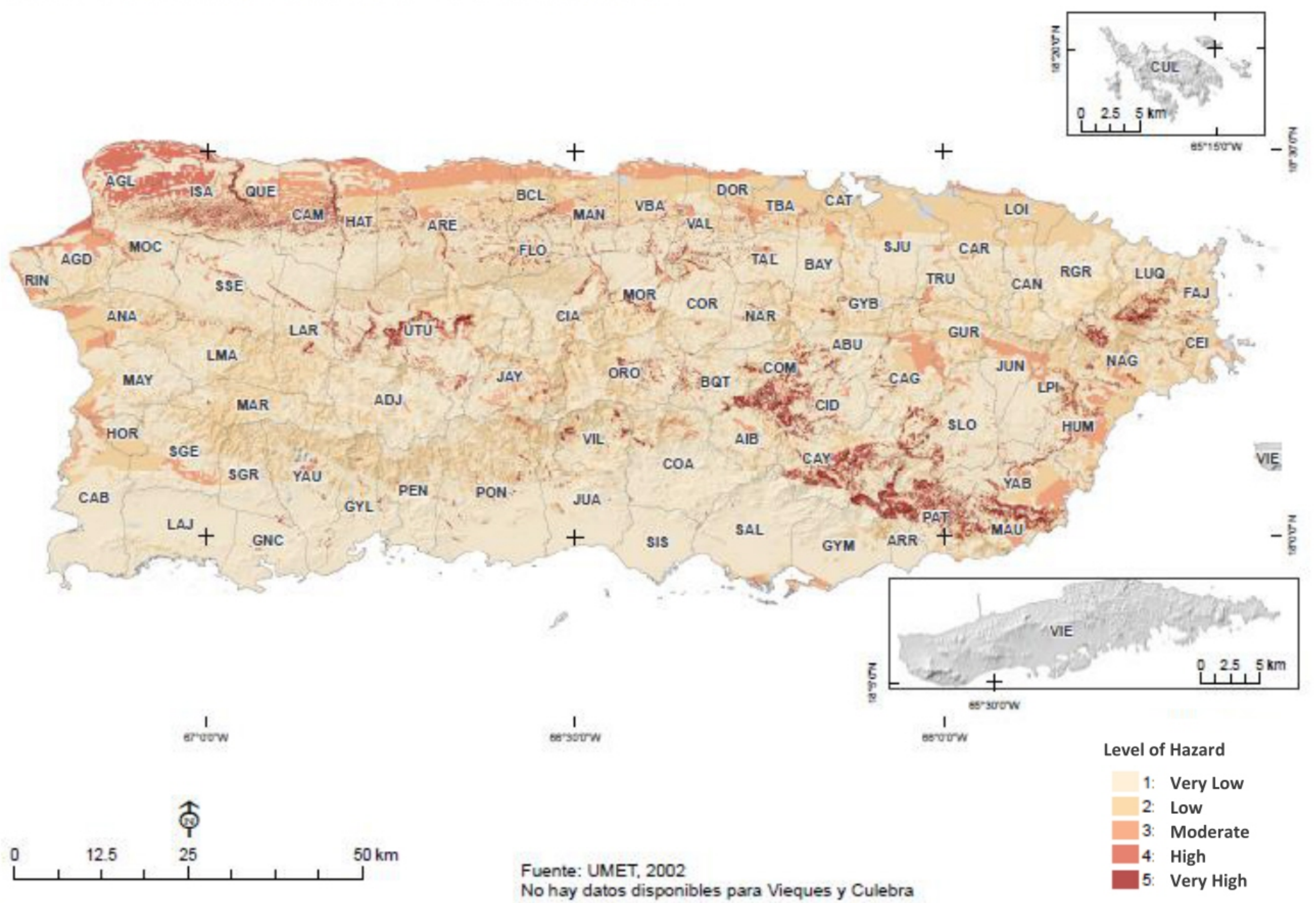
## Graph 2-2

## HAZARD: LIQUEFACTION CAUSED BY EARTHQUAKES

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



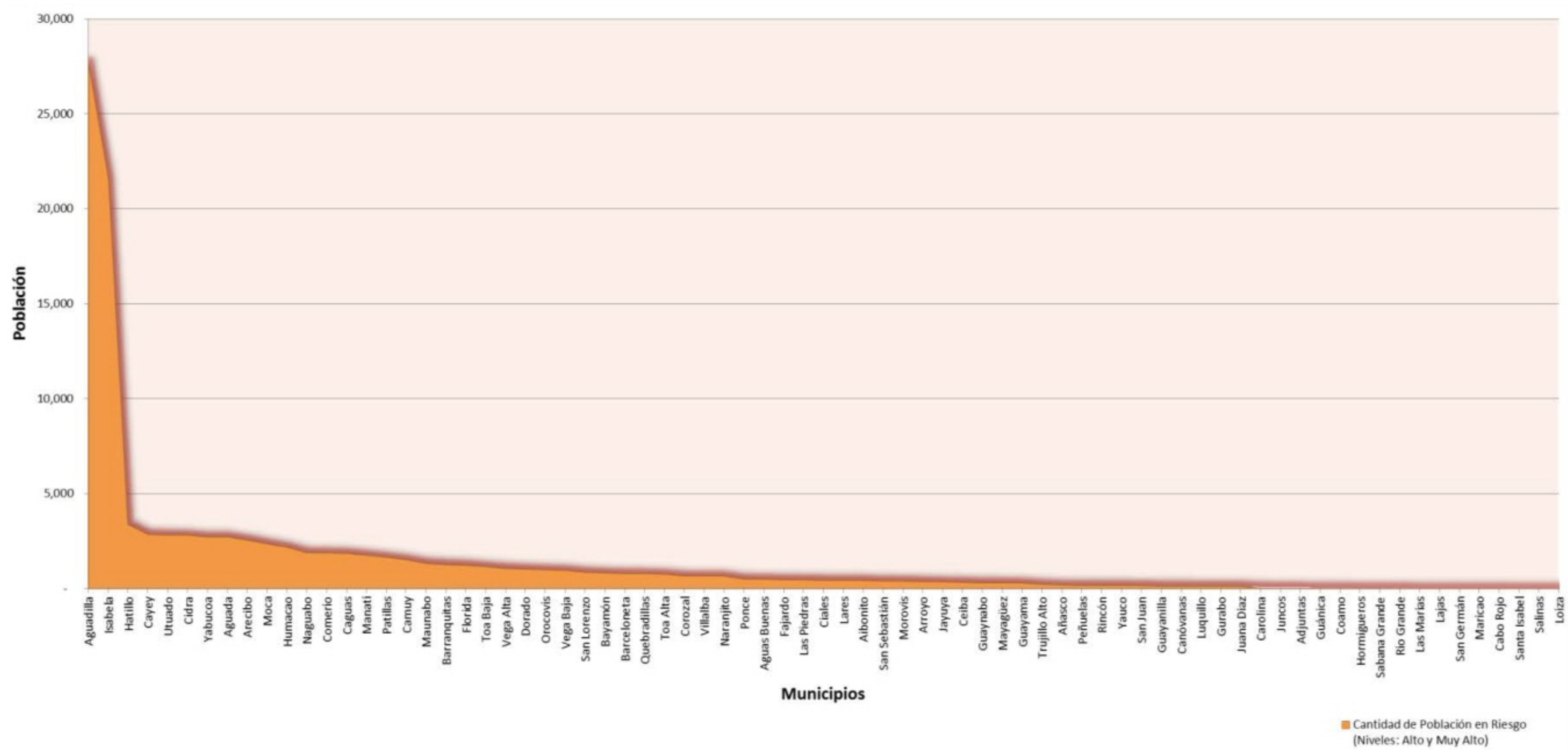
## Map 2-3
# HAZARD: LANDSLIDE CAUSED BY EARTHQUAKES



## Graph 2-3

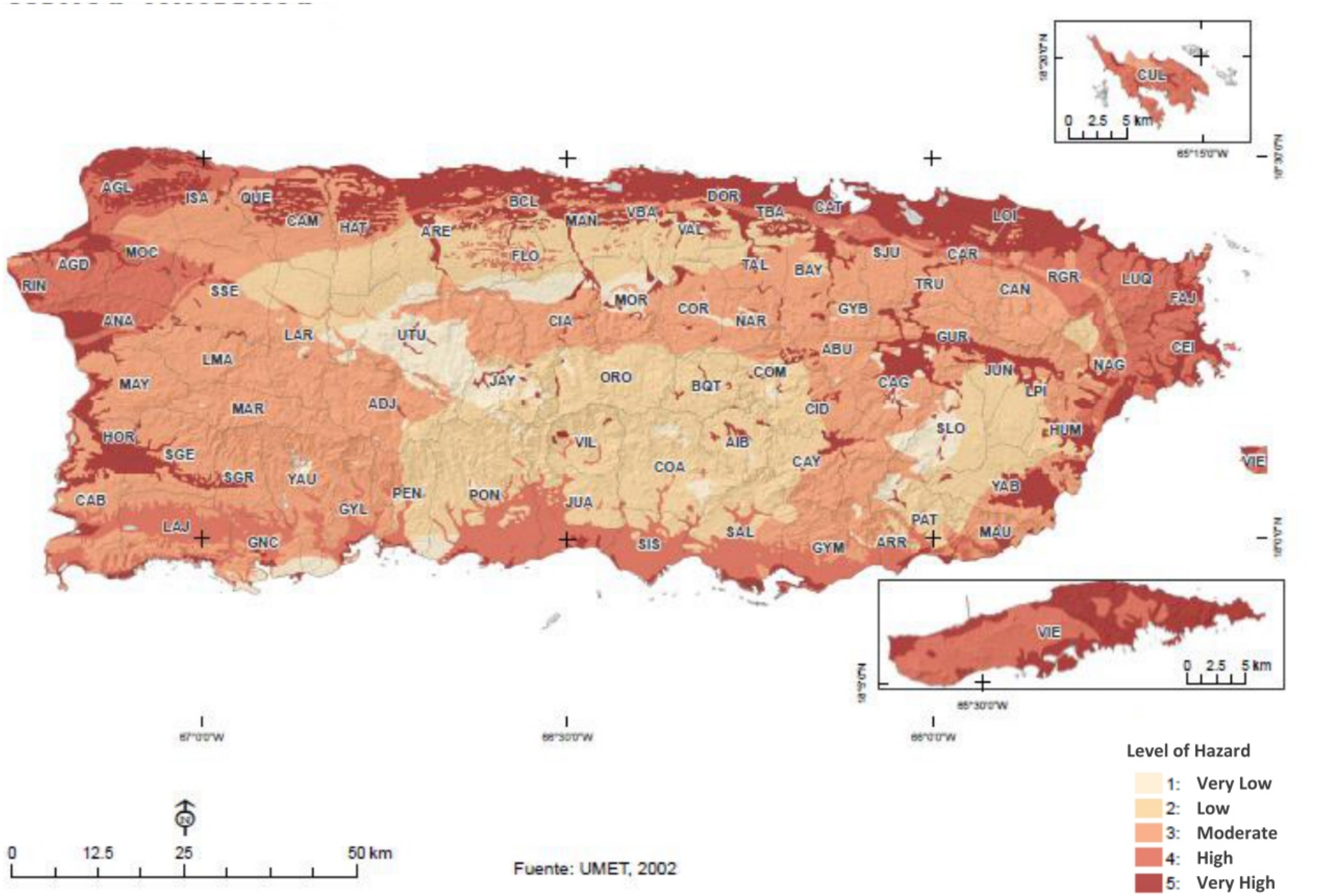
# HAZARD: LANDSLIDE CAUSED BY EARTHQUAKES

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



## Map 2-4

# HAZARD: SEISMIC WAVES CAUSED BY EARTHQUAKES

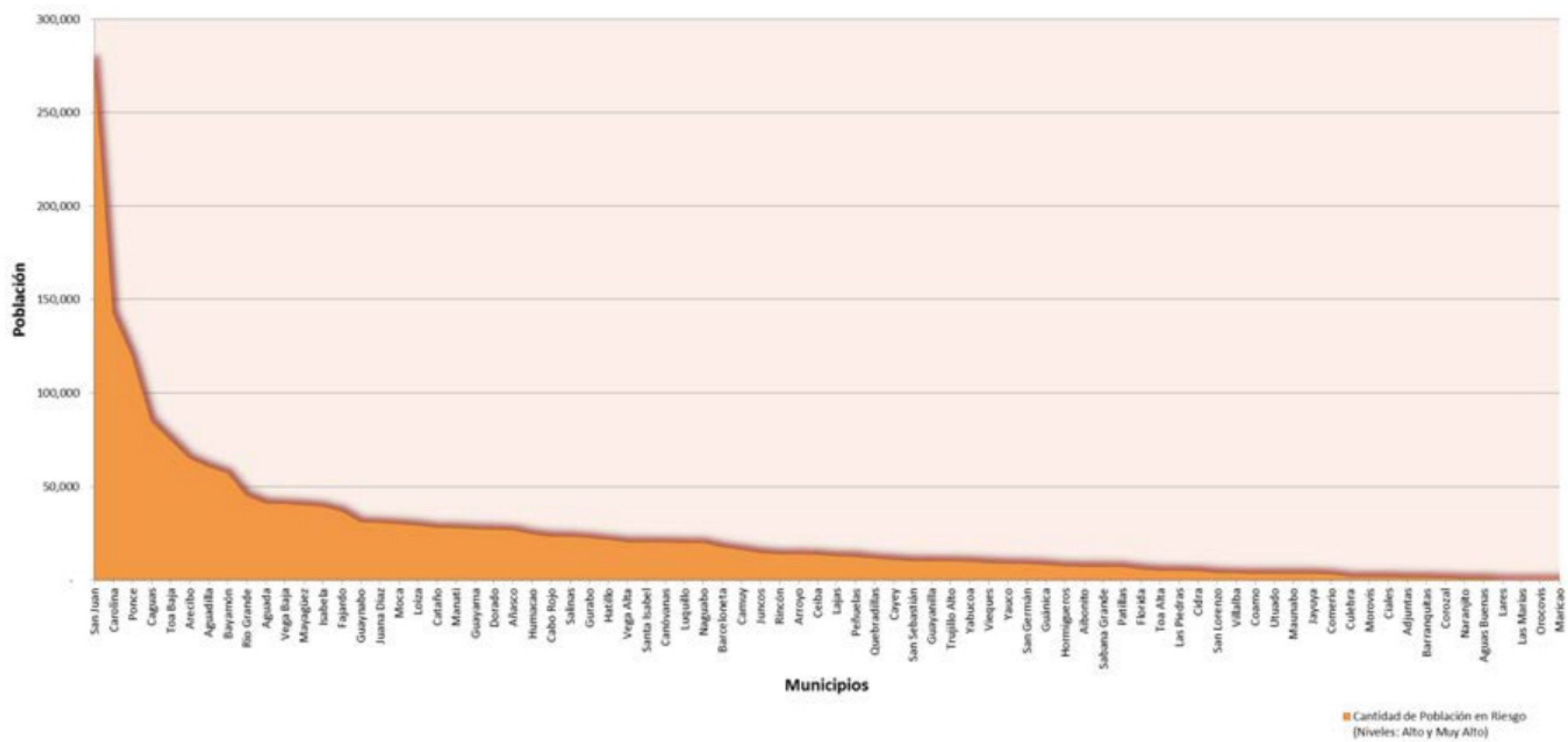



Fuente: UMET, 2002

## Graph 2-4

# HAZARD: SEISMIC WAVES CAUSED BY EARTHQUAKES

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



### 2.2.2.4 Strong Winds (Tropical Storm/Hurricane)

For the analysis of potential impact of strong winds, mostly associated with tropical cyclone events, two layers of geographic information were used. These layers have wind information under five categories or level of hazard. The wind hazard identification was developed following a numerical model of the potential movement of hurricanes combined with procedures developed by the American Society of Civil Engineers (ASCE, 2000) to calculate wind loads. The hurricane wind speed is obtained by the simulation model described in Vickery hurricanes, (2000). Of the analysis, it was obtained that the 10 municipalities with most affected population by strong winds, in the levels high and very high risk, are:

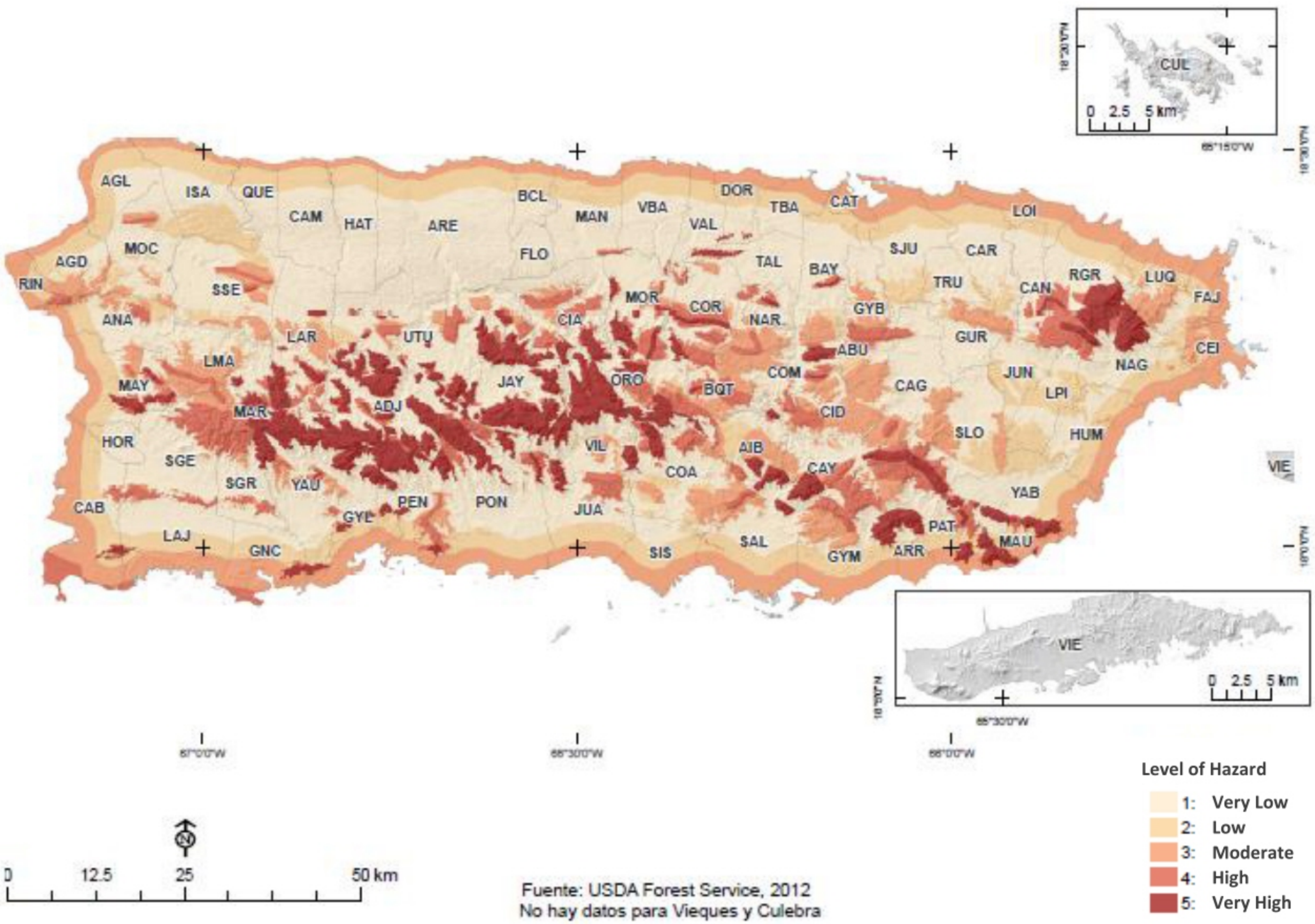
| RANK OF POTENTIALLY AFFECTED POPULATION HAZARD: *Strong Winds (Tropical Storm/Hurricane)* | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| Barranquitas | 30,319 | 11,912 | 39.29% | 1 |
| Orocovis | 23,422 | 10,940 | 46.71% | 2 |
| Aguas Buenas | 28,659 | 8,959 | 31.26% | 3 |
| Adjuntas | 19,483 | 7,577 | 38.89% | 4 |
| Corozal | 37,140 | 7,573 | 20.39% | 5 |
| Ciales | 18,783 | 6,456 | 34.37% | 6 |
| Naranjito | 30,402 | 5,806 | 19.10% | 7 |
| Cidra | 43,478 | 5,561 | 12.79% | 8 |
| Mayagüez | 89,071 | 5,312 | 5.96% | 9 |
| Cayey | 48,114 | 5,149 | 10.70% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-5.

The Map 2-5 shows the possible impact of Strong Winds across Puerto Rico, where it can be seen that mountainous areas are more susceptible to the impact of this risk.

## Map 2-5

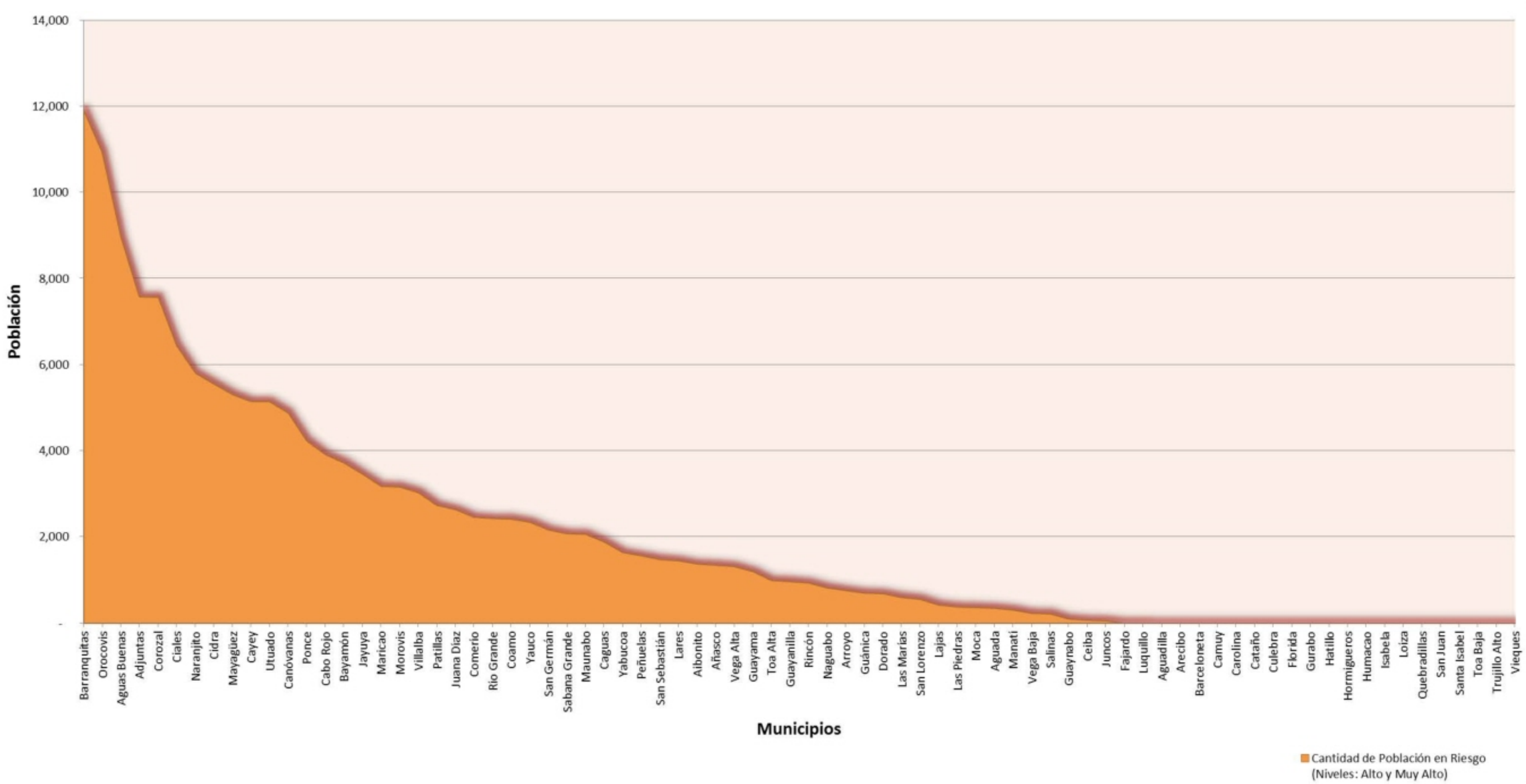
# HAZARD: STRONG WINDS (TROPICAL STORM/HURRICANES)



## Graph 2-5

# HAZARD: STRONG WINDS (TROPICAL STORM/HURRICANES)

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



### 2.2.2.5 Flooding

For the assessment on flood events the new Special Flood Hazard Areas Maps which became effective on November 18, 2009 were used. These maps show 7 categories for Puerto Rico. These categories were given a value using as a base the actual description of each category in order to establish levels of risk or vulnerability. The variables used were the following:

| CATEGORY | VALUE | DESCRIPTION |
|---|---|---|
| **Zone - A** | 4 | Special Flood Hazard Area, SFHA, which identifies the floodplain for the 100-year storm by approximate methods, without the determination of the base flood level. Flood insurance is required. |
| **Zone - AE** | 3 | It is the SFHA that identifies the floodplain for the 100-year storm through a detailed study, including the base flood level. Flood insurance is required. |
| **Zone - AO** | 3 | It is the SFHA that identifies the floodplain for the 100-year storm where the average depth of water is between 1-3 feet. Flood insurance is required. |
| **Zone - VE** | 3 | SFHA is the land that identifies high-risk coastal tides or the 100-year storm event. It identifies the base flood elevation and flood insurance is required. |
| **Zone - X** | 5 | Areas determined to be outside the floodplain with 0.2% annual chance floodplains. |
| **Zone D** | 3 | Areas in which flood hazards are undetermined, but possible. |
| **Zone X(.)** | 2 | Areas of 0.2% annual chance flood, Areas of 100 year flood with average depths of less than 0.3 meter or with drainage area less than 2.6 square kilometers and areas protected by levees from 100-year flood. |

Of the analysis, it was obtained that the 10 municipalities with most affected population by the hazard of flooding, in the levels high and very high risk, are:

| RANK OF POTENTIALLY AFFECTED POPULATION HAZARD: *Flooding* | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| Juana Díaz | 50,743 | 3,894 | 7.67% | 1 |
| Guayama | 47,482 | 1,788 | 3.77% | 2 |
| Naguabo | 26,718 | 1,660 | 6.21% | 3 |
| Aguada | 41,961 | 1,555 | 3.71% | 4 |
| Salinas | 31,078 | 1,421 | 4.57% | 5 |
| Aibonito | 25,899 | 1,391 | 5.37% | 6 |
| Carolina | 176,765 | 1,336 | 0.76% | 7 |
| Ponce | 166,326 | 1,108 | 0.67% | 8 |
| Mayagüez | 89,071 | 1,079 | 1.21% | 9 |
| Patillas | 19,276 | 1,075 | 5.58% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-6.

In the Map 2-6 the areas at risk of flooding can be observed.

### 2.2.2.6 Landslides Caused by Rain

The risk analysis of the landslides caused by rain was made according to three types of basins, studied by Larsen and Torres Sanchez (1996 and 1998), which represent three very different regions of Puerto Rico. The White River basin, Cibuco River basin in north central Puerto Rico, and the Coamo River basin which represents the southern region with a general orientation that faces the south and drier portions of the Island with the average lowest annual rainfall (Larsen and Torres Sánchez, 1996).

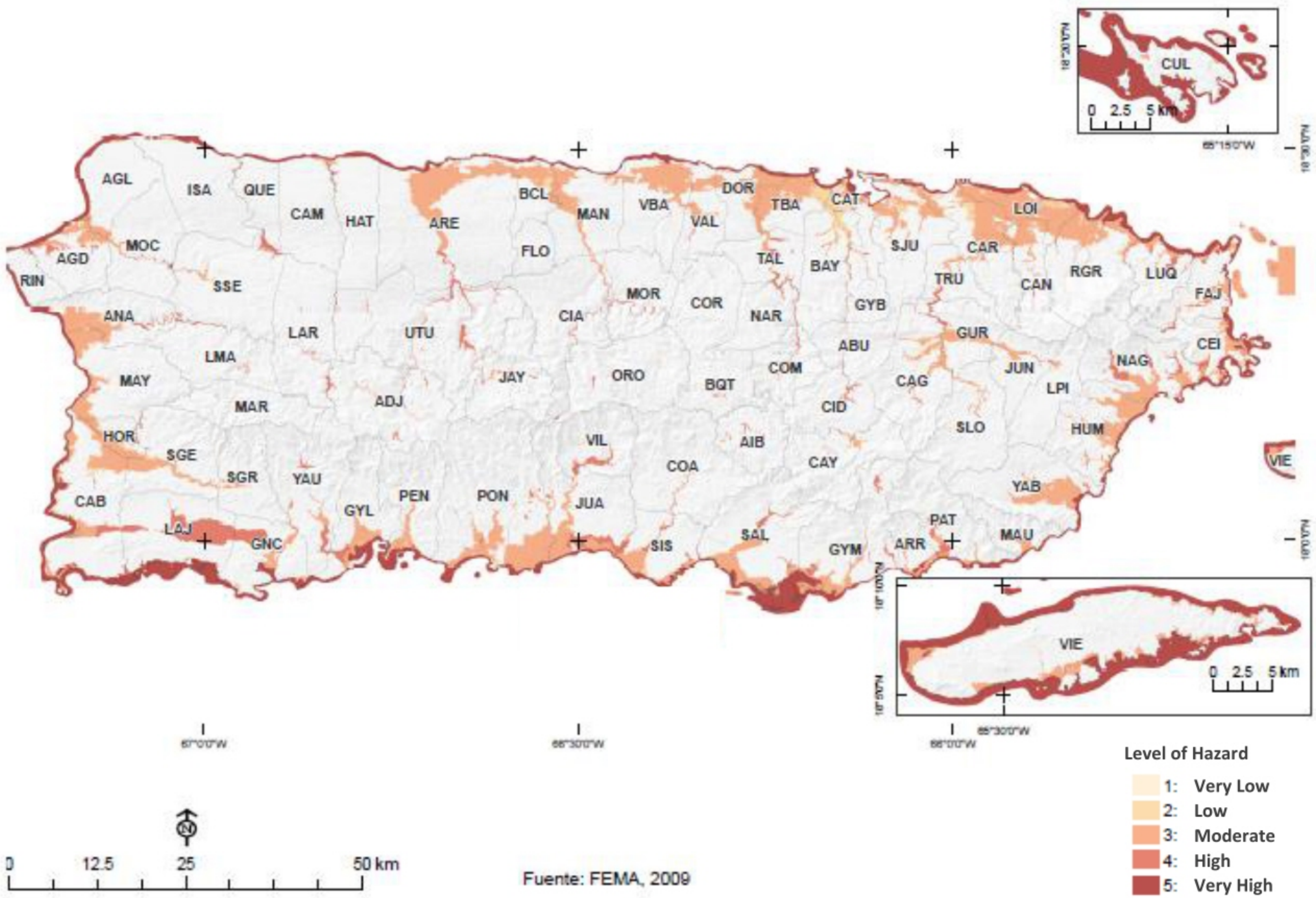
Physiographic and climatic characteristics of the three basins were extrapolated to classify the Island as a whole, similar in three regions, according to: the topography, general orientation of the basin in relation to the wind, the average annual rainfall, and other climatic elements similar and, to a lesser extent, the residual soils and bedrock geology.

The 10 municipalities with most affected population by this hazard, in the high and very high risk levels are shown below, and in the Map 2-7 the areas at risk of landslides caused by rain can be observed.

| **RANK OF POTENTIALLY AFFECTED POPULATION HAZARD: *Landslides Caused by Rains*** | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| Barranquitas | 30,319 | 6,157 | 20.31% | 1 |
| Orocovis | 23,422 | 6,028 | 25.73% | 2 |
| Cayey | 48,114 | 5,720 | 11.89% | 3 |
| Cidra | 43,478 | 5,393 | 12.40% | 4 |
| Naranjito | 30,402 | 4,099 | 13.48% | 5 |
| Lares | 30,751 | 4,059 | 13.20% | 6 |
| Utuado | 33,148 | 3,694 | 11.14% | 7 |
| Aibonito | 25,899 | 3,566 | 13.77% | 8 |
| Adjuntas | 19,483 | 3,537 | 18.15% | 9 |
| Corozal | 37,140 | 3,020 | 8.13% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-7.

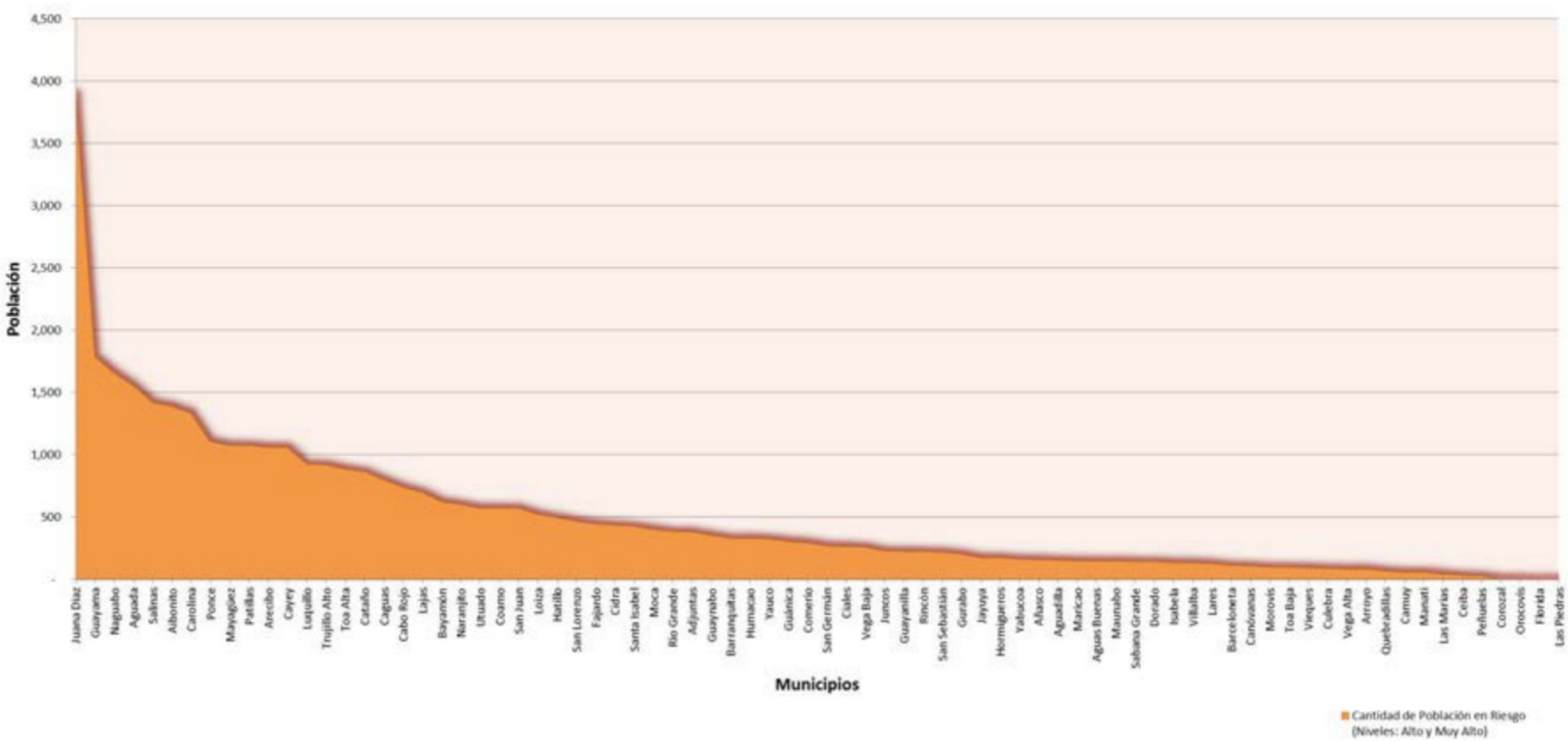
## Map 2-6
# HAZARD: FLOODING



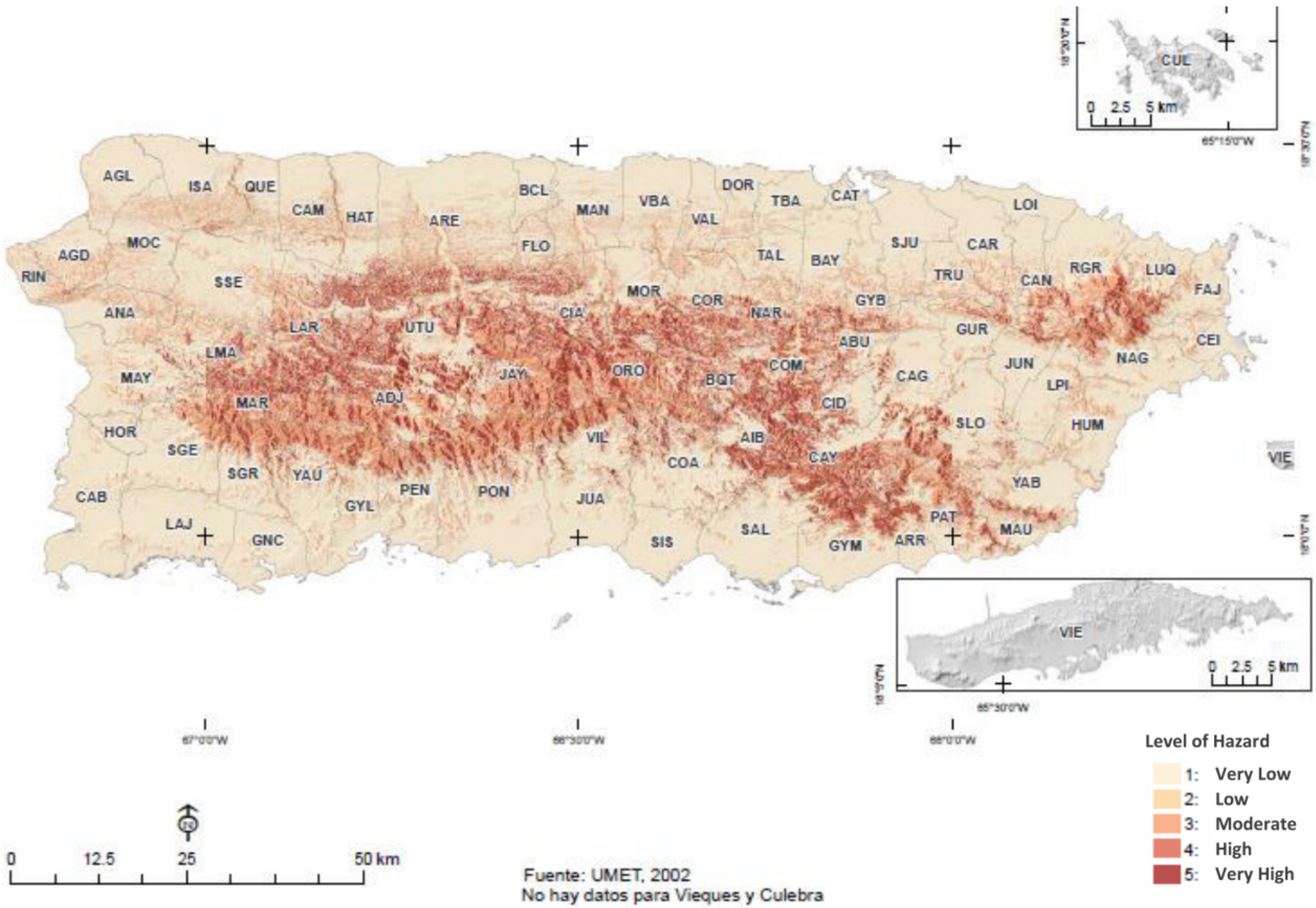
## Graph 2-6

## HAZARD: FLOODING

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



## Map 2-7
# HAZARD: LANDSLIDE CAUSED BY RAINS

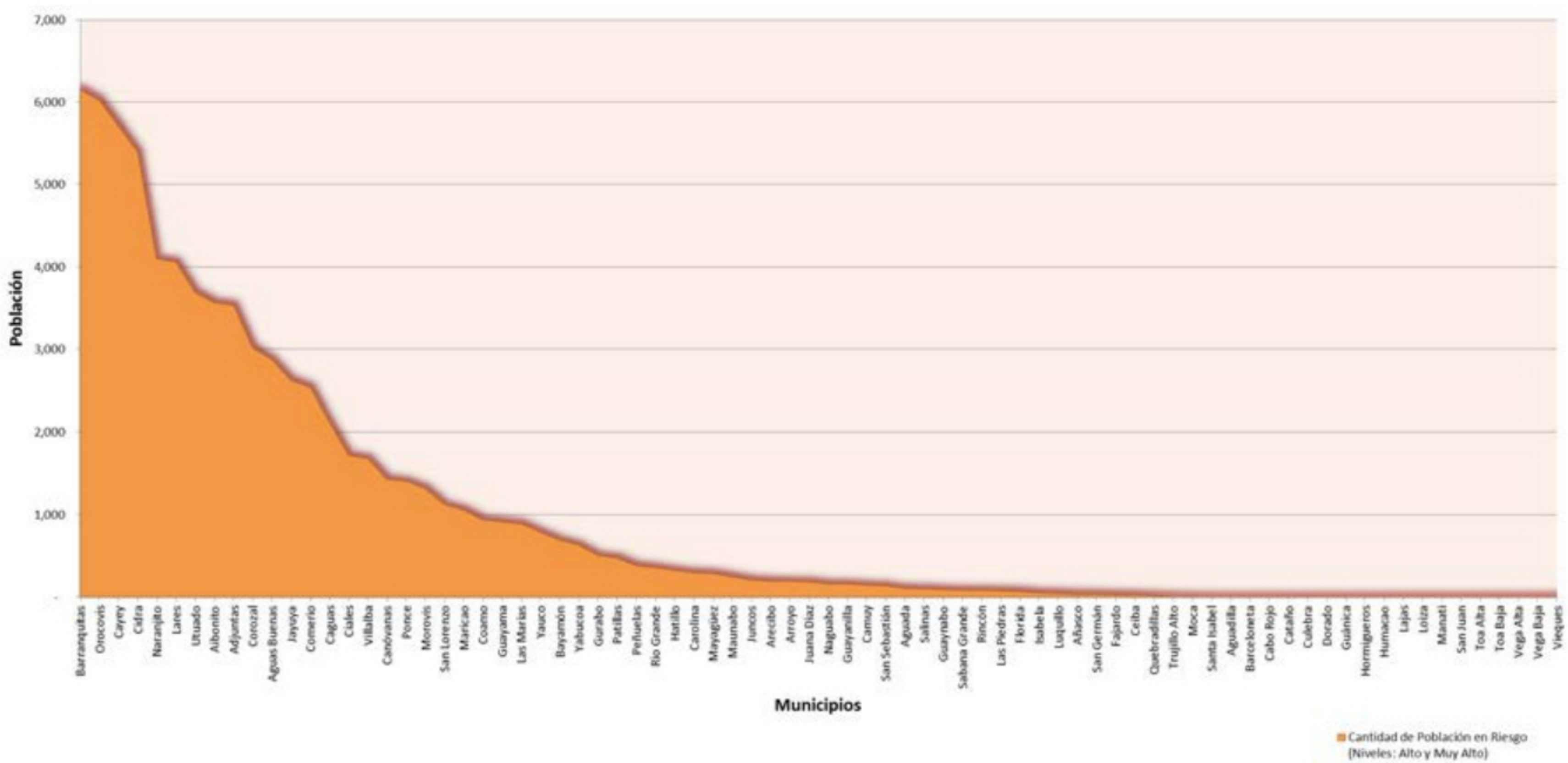



DHS-FEMA-18-0266-C, DHS-FEMA-18-0267-C, DHS-FEMA-18-0268-C.pdf-001538

## Graph 2-7

# HAZARD: LANDSLIDE CAUSED BY RAINS

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



### 2.2.2.7 Tsunamis

For analysis on potential tsunamis, a layer of information produced by the Program for Tsunami Warning and Mitigation from the University of Puerto Rico, Mayaguez Campus was used. The Program for Tsunami Warning and Mitigation, updated the model for most of the north coast of Puerto Rico and Culebra Island in 2012. This layer of information does not establish classifications that define the level of danger or data that would allow the creation of categories. Therefore, a hazard value greater than the tsunami layer that defines the areas of greatest vulnerability through the coastal areas of the Island was applied.

The result of the analysis shows that the 10 municipalities with most affected population by the hazard of Tsunamis, in the high and very high risk levels, are:

| RANK OF POTENTIALLY AFFECTED POPULATION HAZARD: *Tsunamis* | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| Toa Baja | 89,594 | 33,375 | 37.3% | 1 |
| San Juan | 397,814 | 29,951 | 7.5% | 2 |
| Loíza | 30,061 | 19,898 | 66.2% | 3 |
| Mayagüez | 89,071 | 18,118 | 20.3% | 4 |
| Cataño | 28,145 | 11,135 | 39.6% | 5 |
| Carolina | 176,765 | 8,870 | 5.0% | 6 |
| Vega Baja | 59,658 | 5,474 | 9.2% | 7 |
| Arecibo | 96,436 | 5,388 | 5.6% | 8 |
| Aguada | 41,961 | 3,962 | 9.4% | 9 |
| Dorado | 38,161 | 3,576 | 9.4% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-8.

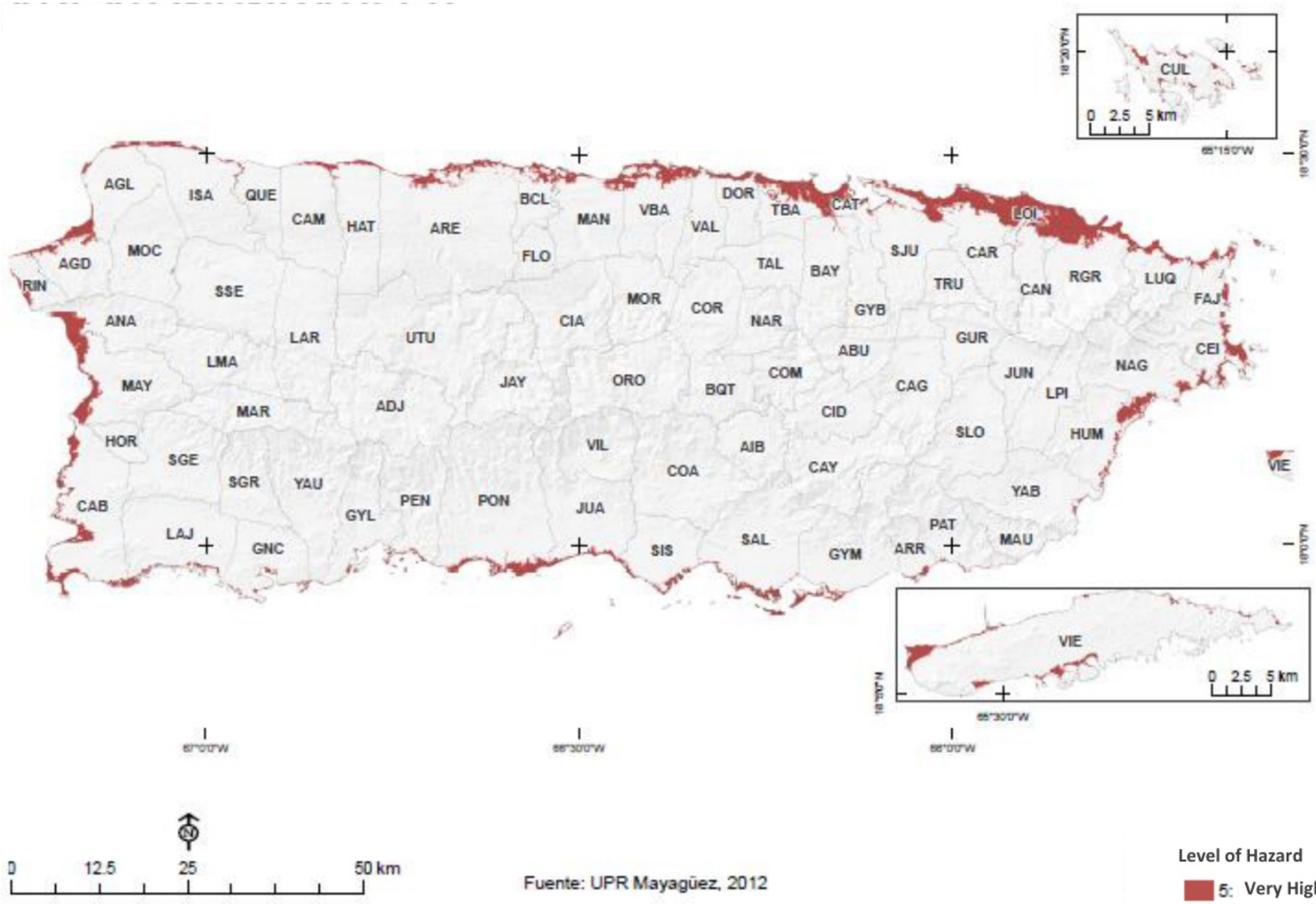
For this revision of PEMPN, it was included a new layer of geographic information about the Evacuation Areas in Case of Tsunami. This layer shows the areas that population have to evict in case of direct or indirect effects of Tsunami. For this reason these areas were assigned a higher hazard value. For the purpose of combined analysis the areas that were the same to those flood zones cause by Tsunami were removed. This way the risk of these areas does not duplicate. The result of the analysis shows that the 10 municipalities with most affected population by the hazard of Evacuation Areas Caused by Tsunamis, in the high and very high risk levels, are:

| **RANK OF POTENTIALLY AFFECTED POPULATION<br>HAZARD:** ***Evacuation Areas in Case of Tsunami*** | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| Toa Baja | 89,594 | 40,376 | 45.1% | 1 |
| San Juan | 397,814 | 38,191 | 9.6% | 2 |
| Loíza | 30,061 | 23,112 | 76.9% | 3 |
| Mayagüez | 89,071 | 17,819 | 20.0% | 4 |
| Carolina | 176,765 | 17,181 | 9.7% | 5 |
| Cataño | 28,145 | 14,437 | 51.3% | 6 |
| Arecibo | 96,436 | 8,712 | 9.0% | 7 |
| Vega Baja | 59,658 | 7,506 | 12.6% | 8 |
| Humacao | 58,480 | 6,696 | 11.4% | 9 |
| Bayamón | 208,114 | 4,887 | 2.3% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-9.

In the Maps 2-8 and 2-9 are shown the flood areas and evacuation areas that could be impacted in a Tsunami event.

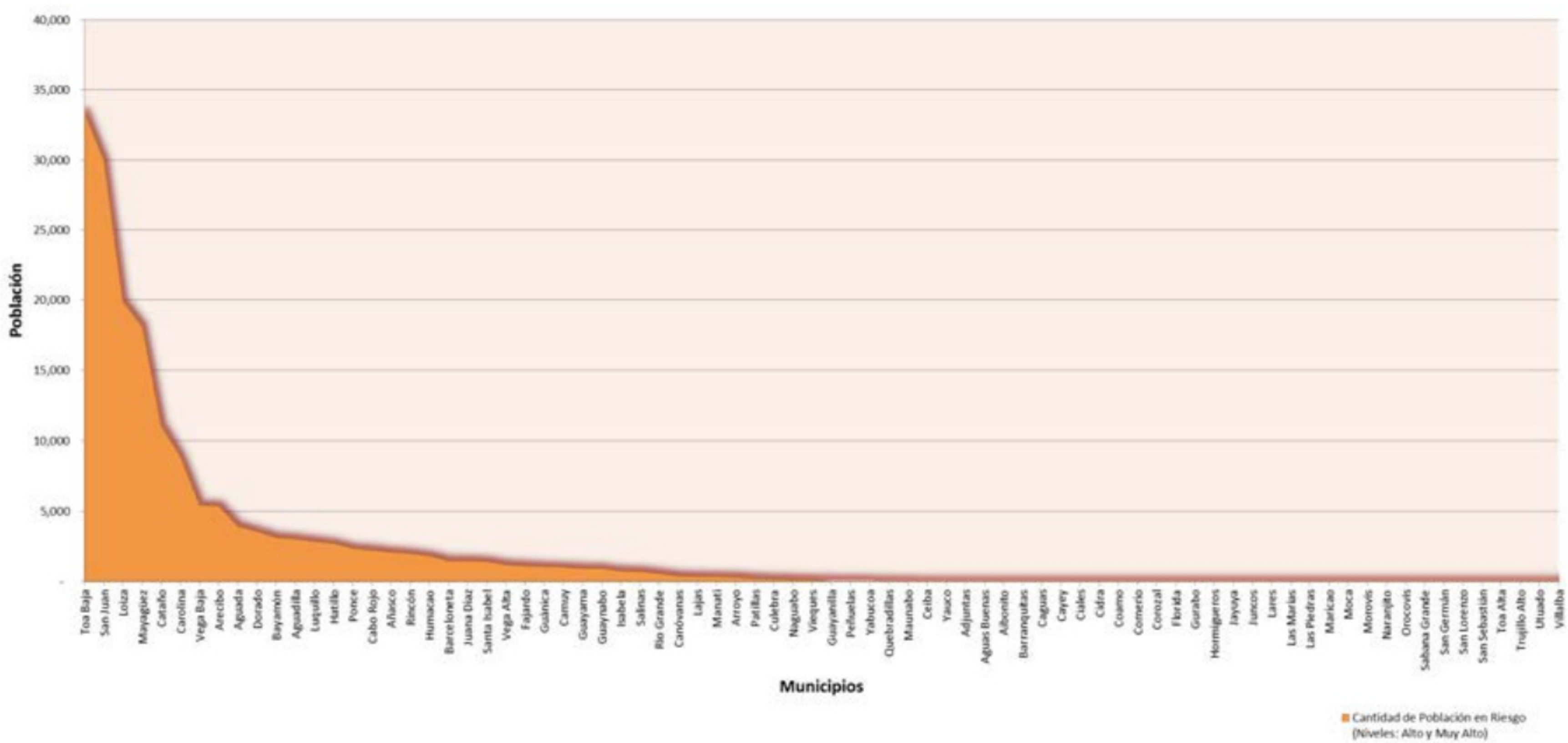
## Map 2-8
## HAZARD: TSUNAMIS



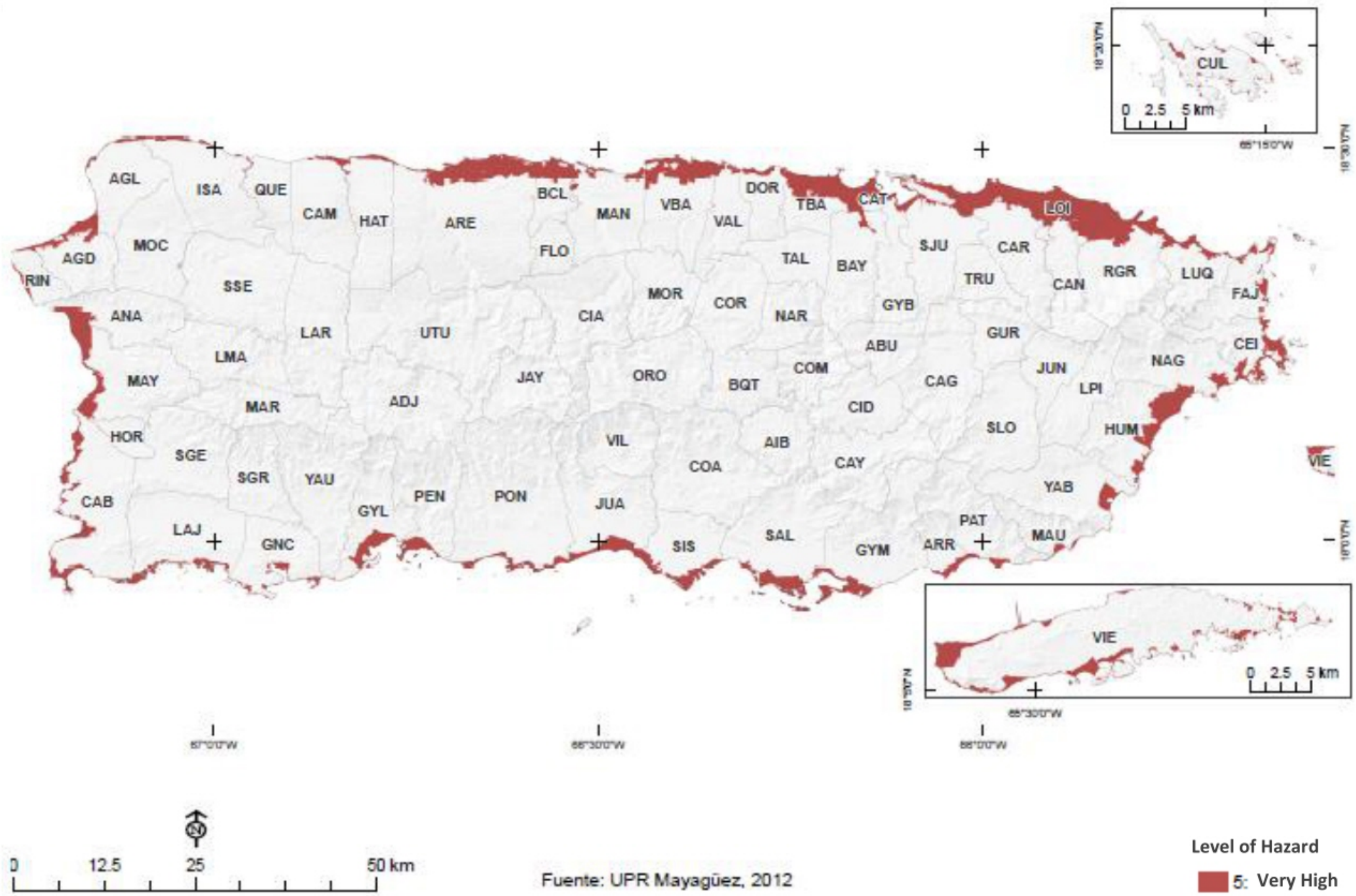
## Graph 2-8

# HAZARD: TSUNAMIS

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



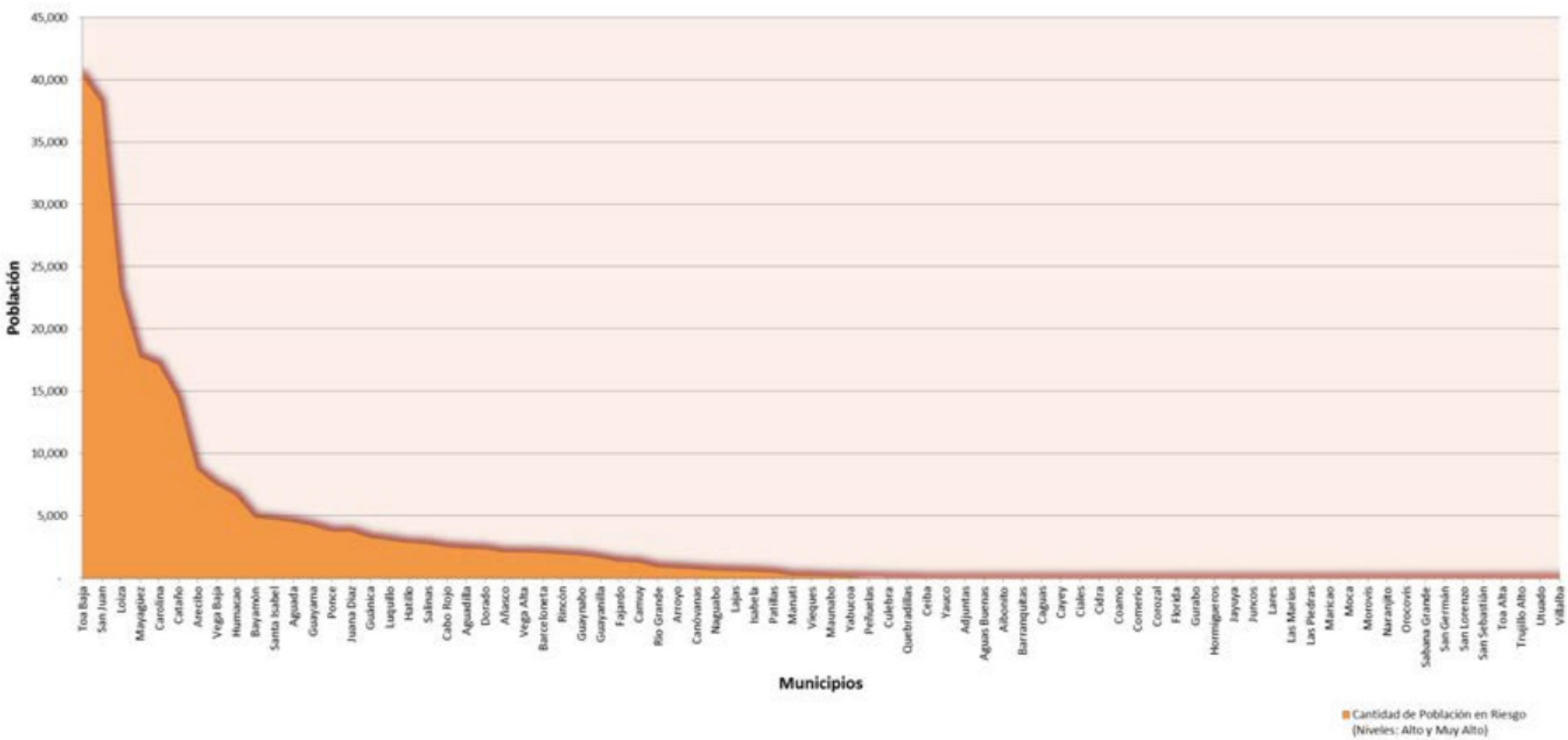
## Map 2-9
# HAZARD: EVACUATION AREAS IN CASE OF TSUNAMIS



## Graph 2-9

# HAZARD: EVACUATION AREAS IN CASE OF TSUNAMIS

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



### 2.2.2.8 Wildfires

The level of the wildfire's geographic information, was developed by the Texas Forest Service in colaboration with the Environmental Forest Service and the Department of Natural Resources of Purto Rico (2012), which provides data on land usage , classification of housing, and municipal boundaries. This geographic data takes into consideration the municpalities of the South area of the island, which has been previously determined at increased risk of forest fires. The same, in the original study, is classified in 10 risk levels. Although, to include it in the PEMPN analysis, they were grouped between the 5 risk categories established (very low and very high).

The areas susceptible to fires are shown in the Map 2-10 and the 10 municipalities with most affected population by this hazard, in the high and very high risk levels, are shown below.

| **RANK OF POTENTIALLY AFFECTED POPULATION RIESGO: *Wildfires*** | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| Ponce | 166,326 | 40,654 | 24.4% | 1 |
| Cabo Rojo | 50,909 | 32,331 | 63.5% | 2 |
| Juana Díaz | 50,743 | 26,193 | 51.6% | 3 |
| Coamo | 40,511 | 25,639 | 63.3% | 4 |
| Yauco | 42,043 | 21,219 | 50.5% | 5 |
| Guayama | 47,482 | 18,245 | 38.4% | 6 |
| Lajas | 25,751 | 17,631 | 68.5% | 7 |
| San Germán | 35,524 | 16,970 | 47.8% | 8 |
| Sabana Grande | 25,264 | 14,444 | 57.2% | 9 |
| Villalba | 26,070 | 14,358 | 55.1% | 10 |

* Data of other municipalities can be found in the Appendix 2-C and Graph 2-10.

### 2.2.2.9 Increase in Sea Level Caused by Climate Change

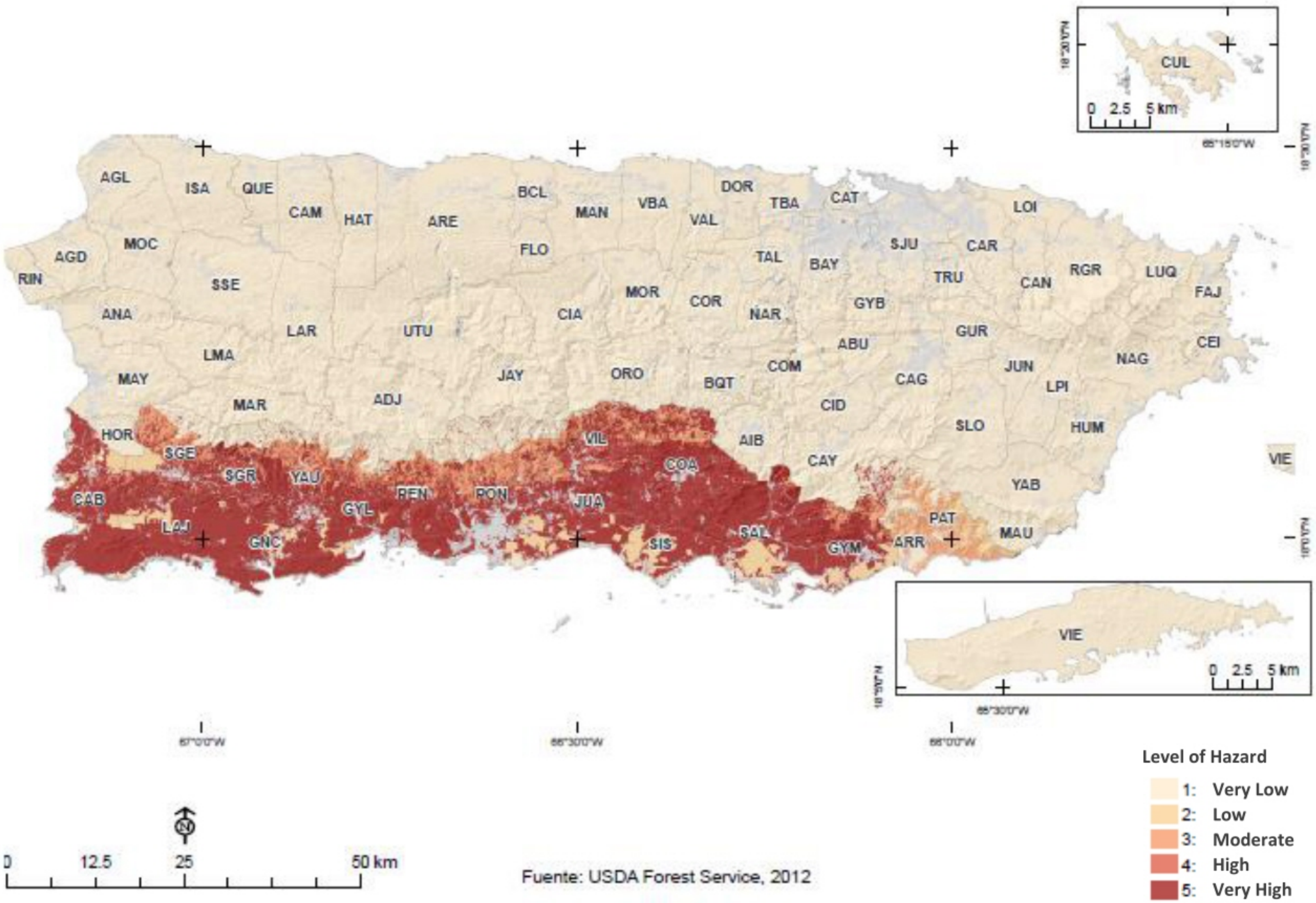
The risk analysis of the increase in sea level due to climate change, was incorporated in the present PEMPN review. This level of geographic information, is product of the 2014 Coastal Services of the National Oceanic and Atmospheric Administration (NOAA). Through an elevation model and sea data levels, tidial parameters were established to demonstrated the penetration of the sea into the coastal land from 1 to 6 feet high. For this risk analysis, the highest, the maximum coverage level (6 feet), and a very high risk category were used because thsi scenario states that these areas will be completely submerged.

The areas susceptible to the increase in the sea level caused by climate change are shown in the Map 2-11 and the 10 municipalities with most affected population by this hazard, in the high and very high risk levels, are shown below.

| RANK OF POTENTIALLY AFFECTED POPULATION<br>HAZARD: *Increase in the Sea Level Caused by Climate Change* | | | | |
|---|---|---|---|---|
| **Municipalities*** | **Total Population** | **Population at Risk *Levels: High and Very High*** | **% of Population at Risk** | **Rank** |
| San Juan | 397,814 | 36,884 | 9.27% | 1 |
| Cataño | 28,145 | 9,978 | 35.45% | 2 |
| Loíza | 30,061 | 8,744 | 29.09% | 3 |
| Carolina | 176,765 | 8,605 | 4.87% | 4 |
| Guaynabo | 97,923 | 4,912 | 5.02% | 5 |
| Ponce | 166,326 | 3,257 | 1.96% | 6 |
| Salinas | 31,078 | 3,025 | 9.73% | 7 |
| Guayama | 47,482 | 2,981 | 6.28% | 8 |
| Toa Baja | 89,594 | 2,891 | 3.23% | 9 |
| Humacao | 58,480 | 2,241 | 3.83% | 10 |

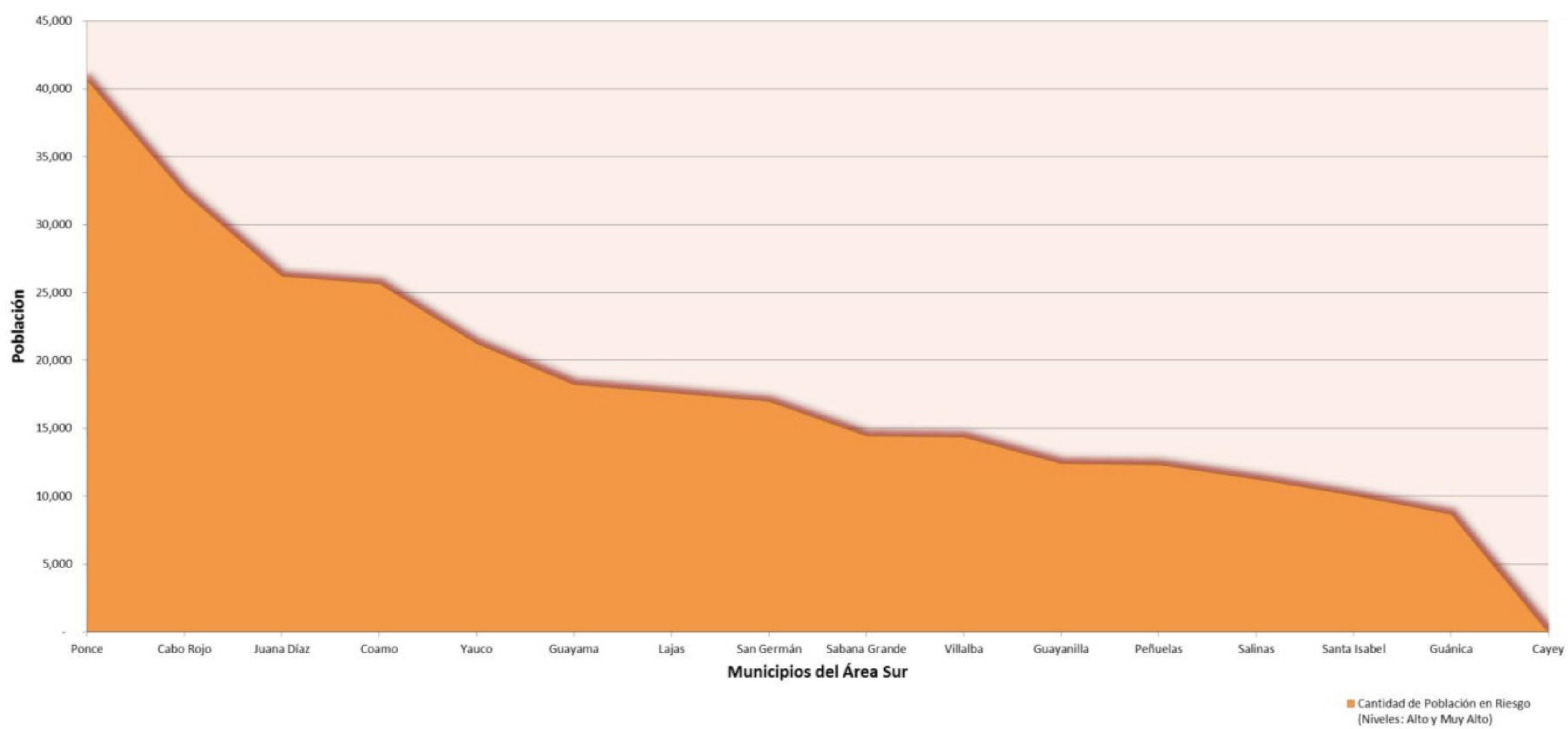
* Data of other municipalities can be found in the Appendix 2-C and Graph 2-11.

## Map 2-10
## HAZARD: Wildfire



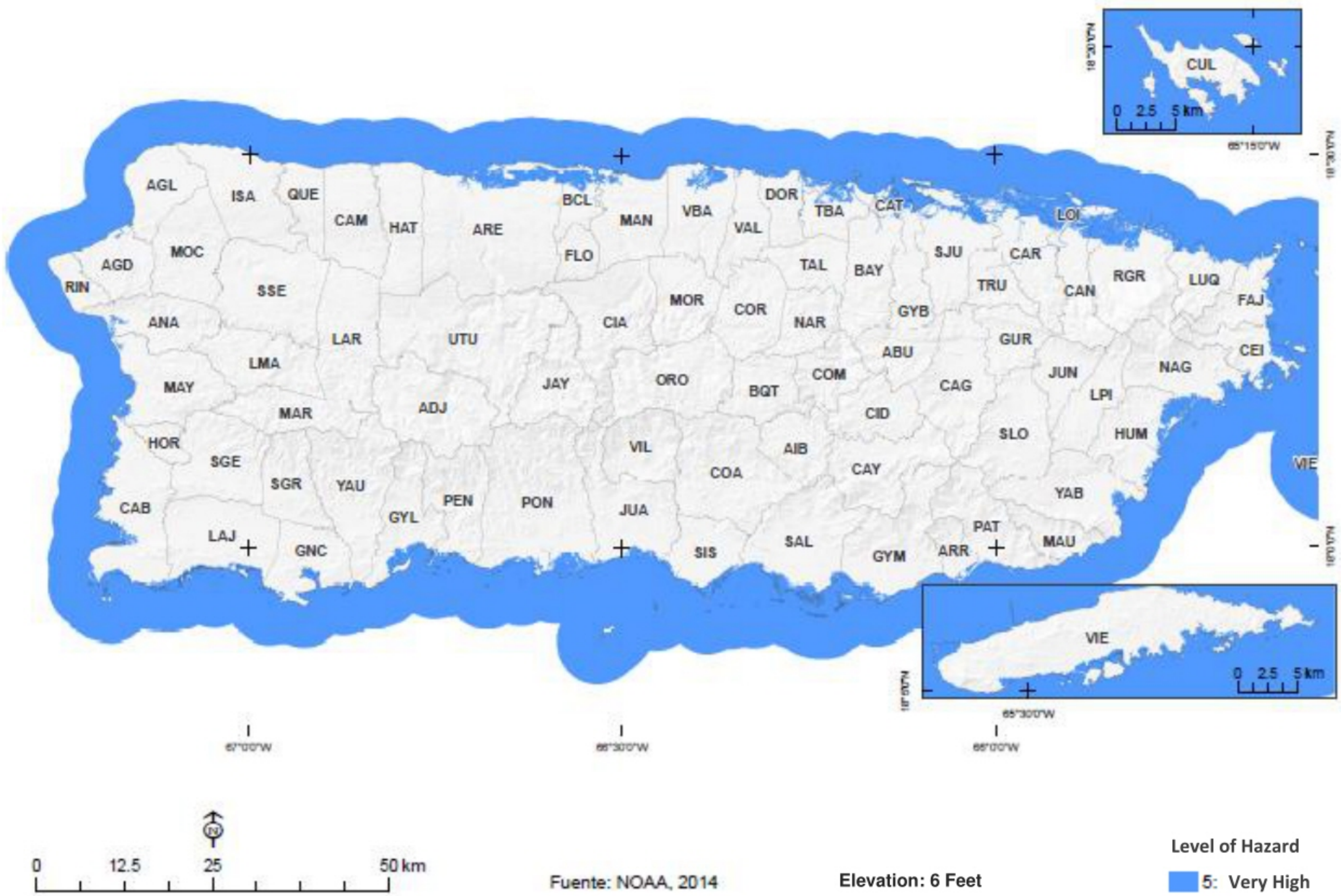
## Graph 2-10
# HAZARD: Wildfire

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH
***Municipalities of South Area***



## Map 2-11

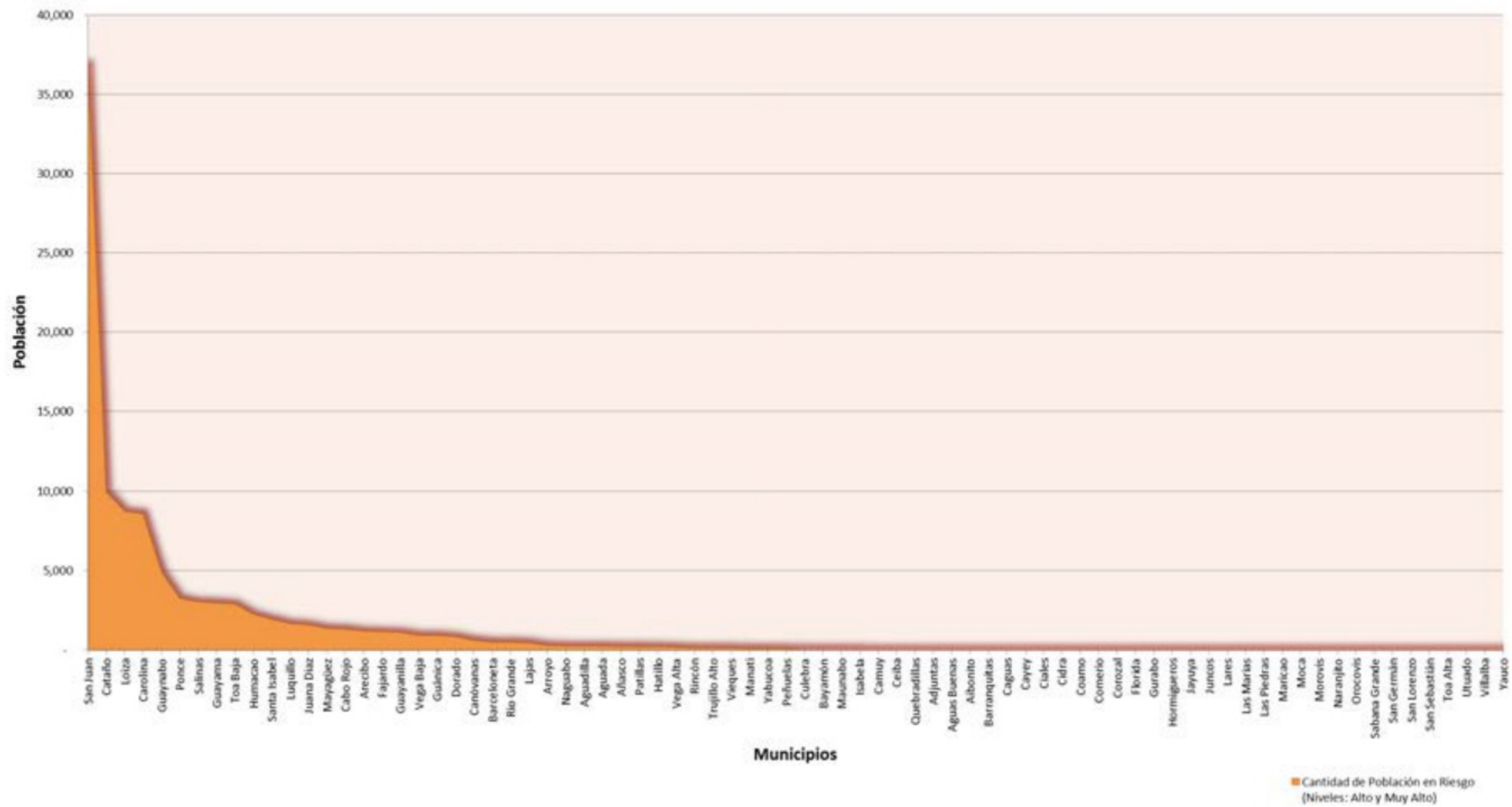
## HAZARD: INCREASE IN THE SEA LEVEL CAUSED BY CLIMATE CHANGE



## Graph 2-11

# HAZARD: INCREASE IN THE SEA LEVEL CAUSED BY CLIMATE CHANGE

### POPULATION AT RISK / LEVELS: HIGH AND VERY HIGH



### 2.2.2.10 Integration of Hazards- Composite Map

As a final step of the analysis, an integration of natural hazards study is done through the combination of the potential damage of all natural hazards considered in the PEMPN. Once the potential for injury is quantified, the estimated hazard damages are cumulative overlapped (through an application of GIS) to create a natural hazard composite map or a multi-hazard map. The composite map illustrates the aggregate levels of geographic information (geodatabase) of the hazards that have been studied in the PEMPN.

To carry out this analysis, first, a geodatabase was created through the GIS. In this geodatabase, the data collected was grouped and required spatial analysis processes were made to create the composite risk level. From this level, the total area can be derived by type of risk. Once the composite risk level is created, proceeded with another spatial analysis which integrated population and housing data to obtain an approximate of the population and housing that could get affected by risk. Then, proceeded to run a routine to analyze all critical infrastructure data submitted by the different agencies and government agencies. This analysis adds up the importance because it reflects the risk situation of the vital infrastructure for the response in case of a natural or human hazard event

The Composite Hazard Map combined the damage estimates for each hazard to show the intensity or compound hazard levels (multiple hazards) across the Island. For the purpose of illustrating this information, estimates of damage compounds were separated into five levels of vulnerability established (1) Very

Low, 2) Low, 3) Moderate, 4) High, and 5) Very High) to the analysis. . The degree in natural hazard levels can be used to inform the general public about the potential of the hazard and to support mitigation activities or projects, planning, and land use.

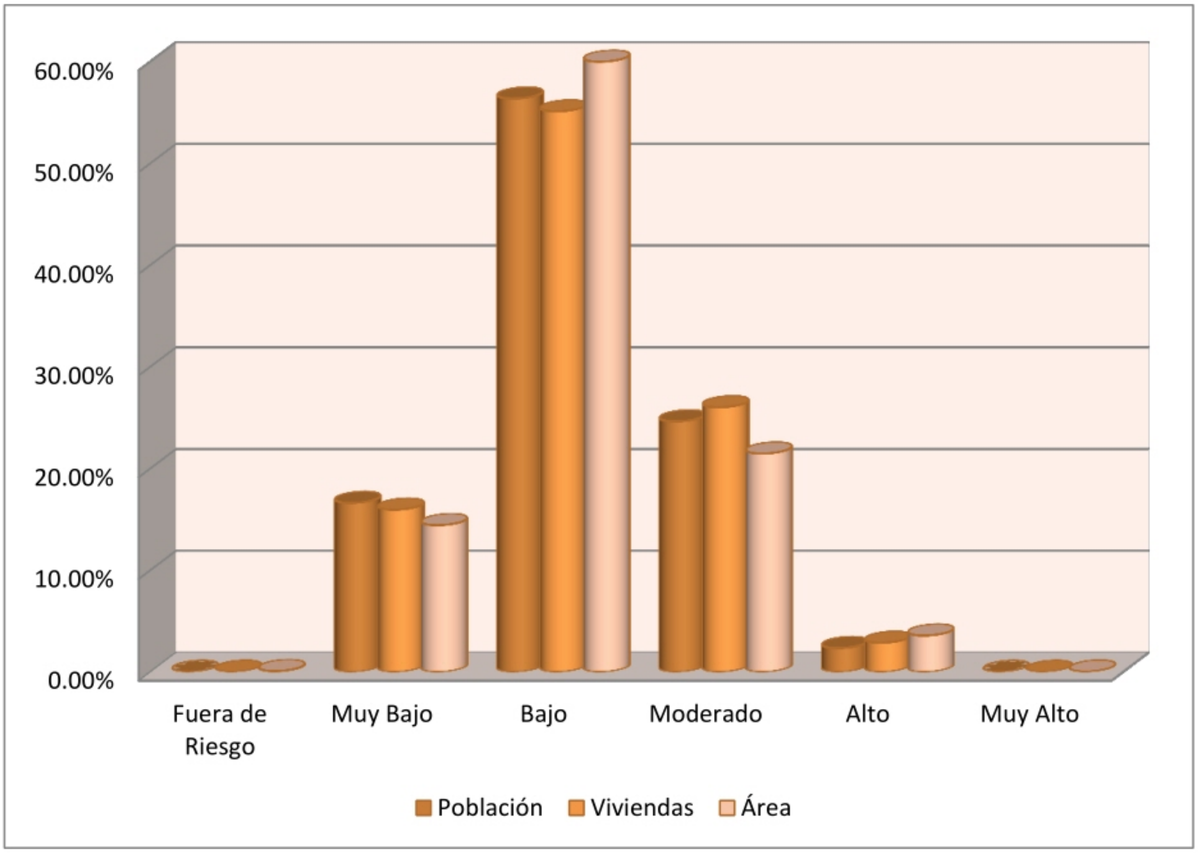
Since in this revision of the PEMPN new geodatabase were integrated (Tsunamis, eviction areas in case of tsunami, and coastal floods caused by climate change) it was necessary to make 2 separate analyses: one directed to coastal municipalities, and another one to non coastal municipalities. This was necessary to avoid bias risk values, increased by the aforementioned levels and that are unique to the coastal municipalities. If this discrimination is not carried out, the areas would reflect values at a very low risk for the non-coastal municipalities. In the Maps 2-12 and 2-13 are included the natural hazards composite maps for coastal and non-coastal municipalities.

The integrated hazards assessment is useful for planning at the regional level. This information was used to locate State Government critical facilities, outline the mitigation strategy, and can be used for other purposes, such as: to identify the possible consequences of the hazards, guide the development toward areas less susceptible to hazards, and provide a basis to support planning decisions in order to reduce the impact of natural on life and property. However, these results do not replace the need to carry out assessments for areas prior to realize constructions or improvements to buildings and other facilities since when analyzing the combined risks, for example, a municipality can have a very high flood irrigation but little or

no risk in other dangers, therefore the combined analysis would have a value of low or moderate risk. Taking into consideration the stated before, it is important that the municipalities visualize and prepare themselves to attend each risk individually.

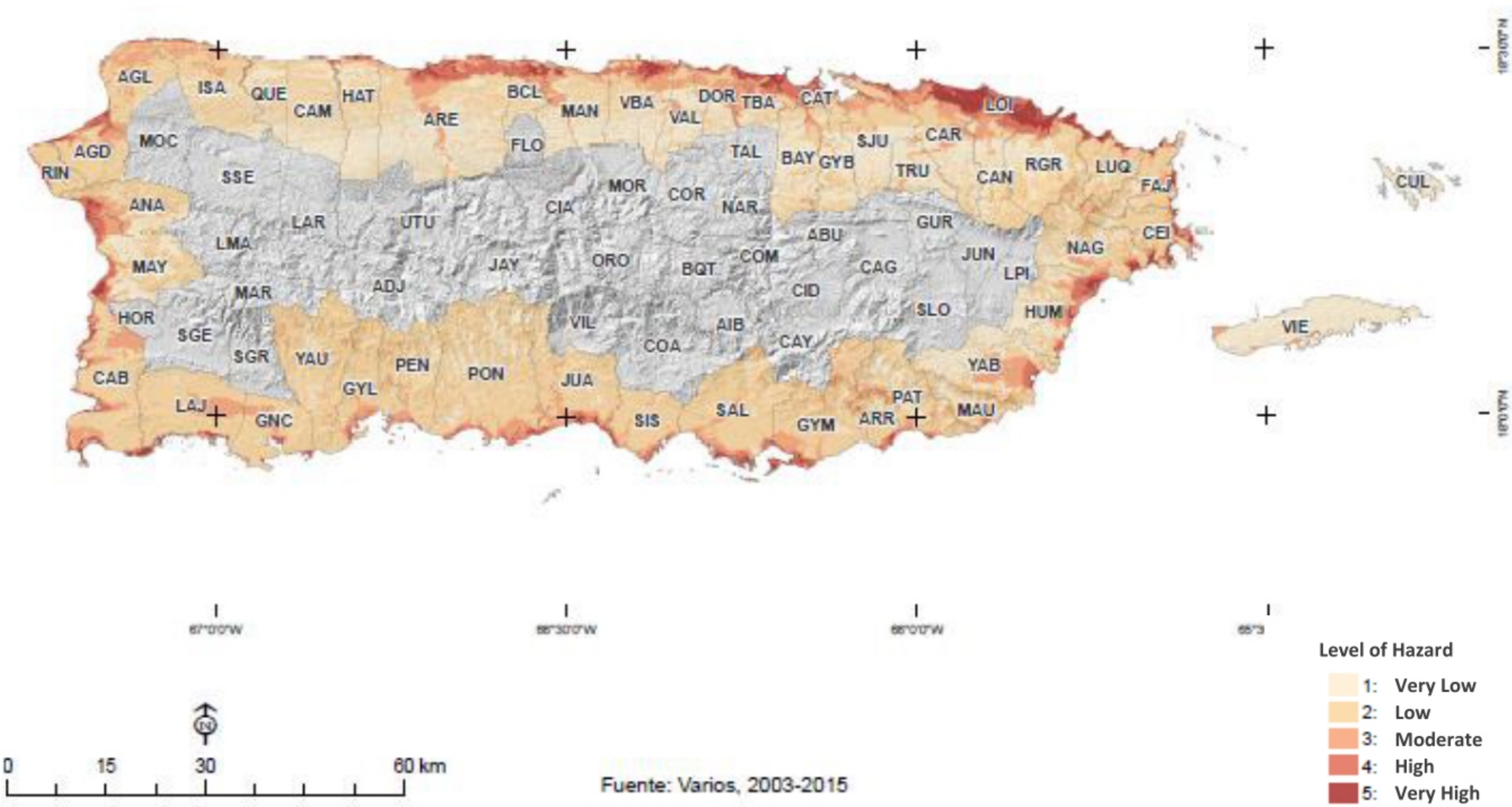
Statistical analysis results showed that approximately 74.8% of the land across Puerto Rico is classified as "Low" or "Very Low" in the level of danger in the composite hazard classification which establishes an indicator of all identified hazards. The same analysis classified 21.4% of the total area potentially exposed to a "Moderate" risk and 3.6% of the territory located in areas with a danger level of "High" or "Very High". The multi-hazard areas are important in hazard mitigation planning, as described in detail in Chapter 3: *Mitigation Strategy*, as they provide opportunities to channel future development in natural hazard areas of low risk. . If these opportunities are taken into account, it will have a significant impact in creating a sustainable future for Puerto Rico. The Graph 2-12 shows the percent of the combined impact of hazard in the population, housing, and area in square meters.

**Graph 2-12**
**Combined Impact of Hazard**



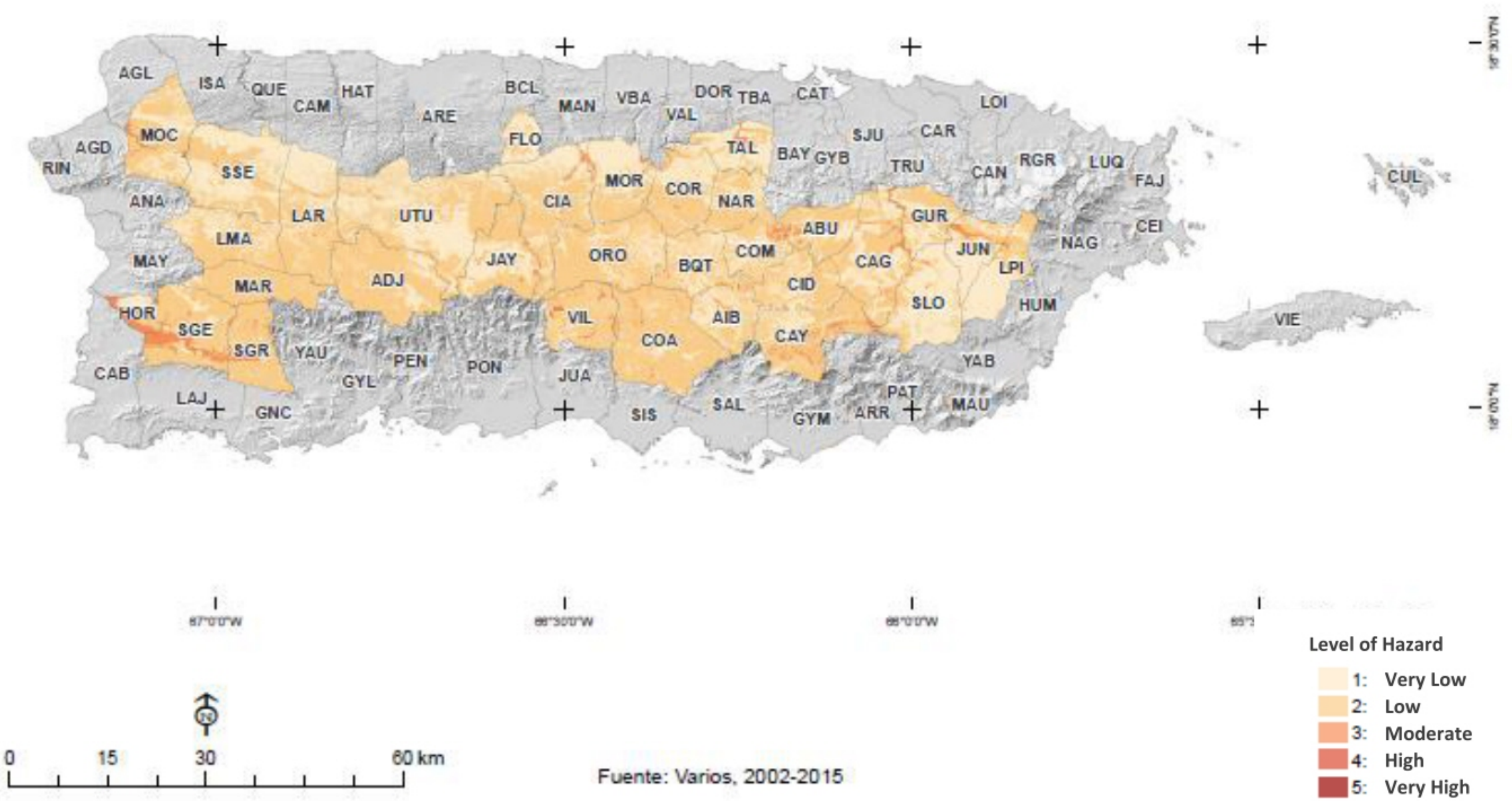
## Map 2-12

# COMBINED HAZARDS: COASTAL MUNICIPALITIES



## Map 2-13

## COMBINED HAZARDS: NO-COASTAL MUNICIPALITIES



## 2.3 Identification of Hazards Vulnerability of the Municipalities

### 2.3.1 Hazard Vulnerability-According to Municipal Mitigation Plans

The identification of natural hazards can affect each municipality, next to the estimated potential losses associated with the identified risks allowed to assign the priority thereof. The greater the risks, the greater the impacts and costs, thereof higher priority. Bothe hazard information such as the estimated potential losses was obtained during the review process of the Local Mitigation Plans. In order to present more information related to the hazards identified priority by the municipalities, information of the 13 municipalities for which information was not obtained for the review of 2016 PEMPN, but were part of the 2011 PEMPN. By this manner, priority information of hazards include data offered by 71 of the 78 municipalities that compose Puerto Rico.

The analysis shows that the priorities of the identified hazards in the Local Mitigation Plans, are:

- Priority 1: Earthquakes
- Priority 2: Tropical Storms / Hurricanes
- Priority 3: Urban and Riverine Flooding
- Priority 4: Landslides Caused by Earthquakes and Rains
- Priority 5: Liquefaction
- Priority 6: Tsunamis
- Priority 7: Urban and Forest Fires
- Priority 8: Coastal Erosion

- Priority 9: Drought
- Priority 10: Hazards Caused by Humans and Other Hazards
- Priority 11: Storm Surge

In summary of the priority hazards by municipality, taking into account the potential losses, presented in the Local Mitigation Plans, it is included in the Appendix 2-B.

### 2.3.2 Hazard Vulnerability of the Municipalities-According to State Analysis and Assessment

The analysis that was completed at the state level for prioritizing municipalities and mitigation strategies, took into consideration three components:

1. An assessment of the incidence or frequency of natural hazards that have affected the territory, according to the presidential disaster and emergency declarations.
2. A count of how frequently these declarations have particularly affected each of the municipalities
3. The results of geospatial analysis conducted to determine the proportion of land area and population potentially exposed to levels of vulnerability to the hazards that were analyzed.

<u>Component 1: Frequency of Presidential Declarations</u>

According to FEMA, there have been 26 Presidential Disaster Declarations in Puerto Rico during the period covering 1956 to the present. Also during this period there have been 6 Presidential Emergency Declarations. The table below shows the presidential

disaster and emergency declarations, the disaster type, declaration number, and the date it occurred.

**Table 2-3**
**Presidential Disaster and Emergency Declarations**

| PRESIDENTIAL DISASTER DECLARATIONS | | | |
|---|---|---|---|
| YEAR | DATE | DISASTER TYPE | DISASTER DECLARATION ID |
| 2011 | 10/18 | Tropical Storm Maria | 4040 |
| 2011 | 08/27 | Rains, Flooding and Landslide caused by Hurricane Irene | 4017 |
| 2011 | 07/14 | Severe Storms, Flooding, Landslides | 4004 |
| 2010 | 10/26 | Severe Storms, Flooding, and Mudslides Landslides Associated with Tropical Storm Otto | 1946 |
| 2010 | 06/24 | Severe Storms, Flooding | 1919 |
| 2008 | 10/01 | Severe Storms, Flooding | 1798 |
| 2005 | 11/10 | Severe Storms, Flooding, Landslides | 1613 |
| 2004 | 09/17 | Tropical Storm Jeanne, Landslides | 1552 |
| 2003 | 11/21 | Severe Storms, Flooding, Landslides | 1501 |
| 2001 | 11/28 | Severe Storms, Flooding | 1396 |
| 2001 | 05/16 | Flooding | 1372 |
| 1998 | 09/24 | Hurricane Georges | 1247 |
| 1996 | 09/11 | Hurricane Hortense | 1136 |
| 1995 | 09/16 | Hurricane Marilyn | 1068 |
| 1992 | 01/22 | Severe Storms, Flooding | 931 |
| 1989 | 09/21 | Hurricane Hugo | 842 |
| 1987 | 12/17 | Severe Storms, Flooding | 805 |
| 1986 | 07/10 | Severe Storms, Flooding, Landslides | 768 |
| 1985 | 10/10 | Severe Storms, Flooding, Landslides | 746 |
| 1985 | 05/31 | Storms, Flooding, Landslides | 736 |

| PRESIDENTIAL DISASTER DECLARATIONS | | | |
|---|---|---|---|
| YEAR | DATE | DISASTER TYPE | DISASTER DECLARATION ID |
| 1979 | 09/02 | Hurricane David | 597 |
| 1975 | 09/19 | Tropical Storm Eloise | 483 |
| 1974 | 11/30 | Flooding | 455 |
| 1970 | 10/12 | Severe Storms, Flooding | 296 |
| 1964 | 05/26 | Extreme Drought | 170 |
| 1956 | 08/18 | Hurricane | 62 |

| PRESIDENTIAL EMERGENCY DECLARATIONS | | | |
|---|---|---|---|
| YEAR | DATE | EMERGENCY TYPE | EMERGENCY DECLARATION ID |
| 2011 | 08/22 | Hurricane Irene | 3326 |
| 2009 | 10/24 | Explosions and Fire | 3306 |
| 1999 | 11/18 | Hurricane Lenny | 3151 |
| 1998 | 09/21 | Hurricane Georges | 3130 |
| 1996 | 11/21 | Gas Leak Explosion | 3124 |
| 1974 | 08/29 | Drought | 3002 |

Source: Federal Emergency Management Agency, October, 2015.

When making an accounting of registered presidential disaster and emergency declaration events, a priority category is obtained based on the frequency at which the effects of these events have had such magnitude that required the intervention of Federal funding to meet the damage. According to the analysis, the priorities arising from the frequency of presidential declarations are as follows:

**PRIORITY** **HAZARD / FREQUENCY**

- Priority 1 .......................Flooding / 16
- Priority 2 .......................Tropical Storms / Hurricanes / 12
- Priority 3 .......................Landslides / 9
- Priority 4 .......................Drought / 2
- Priority 5 .......................Technological Hazard / 2

Component 2: Frequency in which the Municipalities are included in Presidential Declarations

The frequency with which each municipality in the Island has been included in Presidential Disaster Declarations is an indicator of the incidence with which they are affected by various natural hazards affecting the territory. To perform this analysis, the declarations were identified specifying the municipalities affected by the events (there are statements that apply to the entire Island, so do not specify municipalities). The analysis showed that the Municipality of Orocovis had been included in the declaration on 9 occasions, followed by the municipalities of Cayey, Utuado and Villalba 8 times, and with a frequency of 7 Morovis, Naguabo, San Lorenzo and Yabucoa. The frequency in which other municipalities have been included in emergency or disaster declarations can be seen below.

## Table 2.4
## Municipalities Included in Presidential Disaster or Emergency Declarations

| MUNICIPALITIES | Disaster Identification Number, Date and Type of Disaster | | | | | | | | | | | | TOTAL FREQUENCY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1613 (Nov 10, 2005) Severe Storms, Flooding and Landslides | 1552 (Sept 17, 2004) Tropical Storm Jeanne and Landslides | 1501 (Nov 21, 2001) Severe Storms, Flooding and Landslides | 1396 (Nov 28, 2001) Severe Storms, Flooding | 1372 (Mayo 16, 2001) Flooding | 1247 (Sept 24, 1998) Hurricane Georges | 1136 (Sept 11, 1996) Hurricane Hortense | 1946 (Oct 26, 2010) Severe Storms, Flooding and Mudslides Associated to Tropical Storm Otto | 4004 (Jul 14, 2011) Severe Storms, Flooding and Landslides | 3326 (Agosto 22, 2011) Hurricane Irene | 4017 (Agosto 27, 2011) Rains, Flooding, and Landslide | 4040 (Oct 18, 2011) Tropical Storm Maria | |
| Adjuntas | X | X | | | X | X | X | X | | | | | 6 |
| Aguada | | X | | | | X | X | | | | | | 3 |
| Aguadilla | | X | | | | X | X | | | | | | 3 |
| Aguas Buenas | | X | | X | | X | X | | | X | X | | 6 |
| Aibonito | X | X | X | | | X | X | X | | | | | 6 |
| Añasco | | X | | | X | X | X | X | X | | | | 6 |
| Arecibo | | X | | | | X | X | | | | | | 3 |
| Arroyo | | X | X | | | X | X | | | | | | 4 |
| Barceloneta | | X | | | | X | X | | | | | | 3 |
| Barranquitas | | X | | X | | X | X | | | | | | 4 |
| Bayamón | | X | | X | | X | X | | | | | | 4 |
| Cabo Rojo | | | X | | X | X | X | | | | | | 4 |
| Caguas | | X | | | | X | X | | X | X | X | | 6 |
| Camuy | | X | | | | X | X | | X | | | | 4 |
| Canóvanas | | X | X | | | X | X | | | X | X | | 6 |
| Carolina | | X | | | | X | X | | | X | X | | 5 |
| Cataño | | X | | | | X | X | | | | | | 3 |
| Cayey | X | X | | | | X | X | X | | X | X | | 8 |
| Ceiba | | X | | | | X | X | | | X | X | | 5 |
| Ciales | | X | | X | | X | X | X | X | | | | 6 |
| Cidra | | X | | | | X | X | | | X | | | 4 |
| Coamo | | X | | | | X | X | | | | | | 3 |
| Comerío | | X | | | | X | X | | | X | X | | 5 |
| Corozal | | X | | X | | X | X | X | | | | | 5 |
| Culebra | | X | | | | X | | | | | | | 2 |
| Dorado | | X | | | | X | X | | | | | | 3 |

| **MUNICIPALITIES** | Disaster Identification Number, Date and Type of Disaster | | | | | | | | | | | | **TOTAL FREQUENCY** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1613** (Nov 10, 2005) Severe Storms, Flooding and Landslides | **1552** (Sept 17, 2004) Tropical Storm Jeanne and Landslides | **1501** (Nov 21, 2001) Severe Storms, Flooding and Landslides | **1396** (Nov 28, 2001) Severe Storms, Flooding | **1372** (Mayo 16, 2001) Flooding | **1247** (Sept 24, 1998) Hurricane Georges | **1136** (Sept 11, 1996) Hurricane Hortense | **1946** (Oct 26, 2010) Severe Storms, Flooding and Mudslides Associated to Tropical Storm Otto | **4004** (Jul 14, 2011) Severe Storms, Flooding and Landslides | **3326** (Agosto 22, 2011) Hurricane Irene | **4017** (Agosto 27, 2011) Rains, Flooding, and Landslide | **4040** (Oct 18, 2011) Tropical Storm Maria | |
| Fajardo | | X | X | | | X | | | | X | | | 4 |
| Florida | | X | | | | X | X | | | | | | 3 |
| Guánica | | | X | | X | X | X | X | | | | | 5 |
| Guayama | | X | X | | | X | X | X | | | | | 5 |
| Guayanilla | X | X | | | X | X | X | | | | | | 5 |
| Guaynabo | | X | | | | X | X | | | | | | 3 |
| Gurabo | | X | | | | X | X | | | X | | | 4 |
| Hatillo | | X | | | | X | X | | X | | | | 4 |
| Hormigueros | | X | | | X | X | | | | | | | 3 |
| Humacao | | X | | | | X | X | | | X | | | 4 |
| Isabela | | X | | | | X | X | | | | | | 3 |
| Jayuya | X | X | | X | | X | X | X | | | | | 6 |
| Juana Díaz | X | X | X | | | X | X | | | | | X | 6 |
| Juncos | | X | | X | | X | X | | | X | X | | 6 |
| Lajas | | | X | | X | X | | | | | | | 3 |
| Lares | X | X | | | X | X | X | X | | | | | 6 |
| Las Marías | | X | | | X | X | X | X | | | X | | 6 |
| Las Piedras | | X | | | | X | X | | X | | | | 4 |
| Loíza | | X | X | | | X | X | | | X | X | | 6 |
| Luquillo | | X | X | | | X | | | | X | X | | 5 |
| Manatí | | X | | | | X | X | | | | | | 3 |
| Maricao | X | X | | | X | X | X | X | | | | | 6 |
| Maunabo | | X | X | | | X | X | | | X | | | 5 |
| Mayagüez | | | | | | X | X | X | | | | | 3 |
| Moca | | X | | | X | X | X | | | | | | 4 |
| Morovis | | X | | X | | X | X | X | X | | X | | 7 |
| Naguabo | | X | X | | | X | X | | | X | X | X | 7 |
| Naranjito | | X | X | X | | X | X | | | | | | 5 |
| Orocovis | X | X | | X | | X | X | X | X | X | X | | 9 |
| Patillas | | X | X | | | X | X | X | | | | | 6 |
| Peñuelas | X | X | | | | X | X | | | X | | | 6 |

| **MUNICIPALITIES** | Disaster Identification Number, Date and Type of Disaster | | | | | | | | | | | | **TOTAL FREQUENCY** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **1613** (Nov 10, 2005) Severe Storms, Flooding and Landslides | **1552** (Sept 17, 2004) Tropical Storm Jeanne and Landslides | **1501** (Nov 21, 2001) Severe Storms, Flooding and Landslides | **1396** (Nov 28, 2001) Severe Storms, Flooding | **1372** (Mayo 16, 2001) Flooding | **1247** (Sept 24, 1998) Hurricane Georges | **1136** (Sept 11, 1996) Hurricane Hortense | **1946** (Oct 26, 2010) Severe Storms, Flooding and Mudslides Associated to Tropical Storm Otto | **4004** (Jul 14, 2011) Severe Storms, Flooding and Landslides | **3326** (Agosto 22, 2011) Hurricane Irene | **4017** (Agosto 27, 2011) Rains, Flooding, and Landslide | **4040** (Oct 18, 2011) Tropical Storm Maria | |
| Ponce | X | X | | | | X | X | X | | X | | | 6 |
| Quebradillas | | X | | | | X | | | | | | | 2 |
| Rincón | | X | | | X | X | X | | | | | | 4 |
| Río Grande | | X | X | | | X | X | | | | | | 4 |
| Sábana Grande | | | | | X | X | | X | | | | | 3 |
| Salinas | X | X | X | | | X | X | X | | | | | 6 |
| San Germán | | | | | X | X | X | X | | | | | 4 |
| San Juan | | X | | | | X | X | | | | X | | 4 |
| San Lorenzo | | X | | X | | X | X | X | X | X | | | 7 |
| San Sebastián | | X | | | | X | X | | X | | | | 4 |
| Santa Isabel | X | X | X | | | X | X | | | | | | 5 |
| Toa Alta | | X | | | | X | X | | | | | | 3 |
| Toa Baja | | X | X | | | X | X | | | | | | 4 |
| Trujillo Alto | | X | | | | X | X | | | | | | 3 |
| Utuado | X | X | | X | | X | X | X | X | | X | | 8 |
| Vega Alta | | X | | X | | X | X | | | | | | 4 |
| Vega Baja | | X | | | | X | X | | | | X | | 4 |
| Vieques | | X | | | | X | | | | | | | 2 |
| Villalba | X | X | | | | X | X | X | X | X | X | | 8 |
| Yabucoa | X | X | X | | | X | X | X | | | | X | 7 |
| Yauco | X | X | X | | X | X | X | X | | X | | | 5 |

Source: Federal Emergency Management Agency (FEMA)
Note: Table shows only disaster declarations for which data were available per municipality.

## Component 3: Geospatial State Assessment

The state assessment of the municipalities' vulnerability to hazards consists of two components: an assessment of the proportion in terms of the area that potentially could be affected by hazards in each municipality and an assessment of the resident population in these areas.

➢ Areas Potentially Affected by Hazards in the Municipalities

The application of computer program capabilities for the evaluation of information and geo-referenced data allows calculation of statistical information distribution through the defined territories. The Plan's completed analysis evaluated according to information available, the hazards affecting the territory of Puerto Rico and the different risk levels that could affect different sectors. Based on the data provided, the electronic program divides the territory into multiple polygons that identify the type of hazard and the potential level of vulnerability.

For the analysis of areas potentially exposed to natural hazards, a statistical evaluation was performed in which a calculation of the measure in square meters of the areas that were exposed to each of the different levels of risk or vulnerability was obtained throughout the Island and for each of the identified natural hazards. The data obtained with this analysis, was combined with the municipal boundary information to segregate information at municipal level. The results were statistical tables with the quantities and percent of municipal territories that were potentially exposed to natural hazard for each level. The size

of the exposed area allowed to establish a rank order from the municipality potentially more exposed to the less exposed. These results served for establishing priorities in the implementation of mitigation strategies and actions across the Country. In the Appendix 2-C are included the tables that summarize the results of this analysis and prioritize the ranges for each hazard.

➢ Population Potentially Affected by Hazards in the Municipalities

A similar analysis described in the previous section was carried out to evaluate the population that could be exposed to each of the hazards, in the Island and Municipal levels. Again, with the intention of establishing an objective ranking of the priority that each municipality would have, based on the population potentially exposed to natural hazards. To make this evaluation it was incorporated the census population data, at block-level, to the hazards data available and was identified the number of people residing in areas potentially susceptible to each of the identified hazards.

The results of the analysis, allowed to develop tables in which the municipalities were arranged, based on the number of people potentially exposed and served as one of the criteria in assigning priorities for the allocation of resources and technical assistance proposed in the PEMPN. In the Appendix 2-C are included the tables with the analysis results. Taken as a principal criterion of ranking, the population that could potentially be affected, for the two highest levels of vulnerability ("High" and "Very High"), is presented below the top ten municipalities for each of the natural hazards evaluated.

## Table 2-5
## Rank Priority of the Municipalities by Hazards

| Priority | Earthquakes | Seismic Wave caused by Earthquakes | Landslides caused by Earthquakes | Liquefaction caused by Earthquakes | Strong Winds Storms / Hurricane |
|---|---|---|---|---|---|
| **1** | San Juan | San Juan | Aguadilla | San Juan | Barranquitas |
| **2** | Carolina | Carolina | Isabela | Carolina | Orocovis |
| **3** | Caguas | Ponce | Hatillo | Toa Baja | Aguas Buenas |
| **4** | Toa Baja | Caguas | Cayey | Mayagüez | Adjuntas |
| **5** | Arecibo | Toa Baja | Utuado | Bayamón | Corozal |
| **6** | Aguadilla | Arecibo | Cidra | Cataño | Ciales |
| **7** | Bayamón | Aguadilla | Yabucoa | Loíza | Naranjito |
| **8** | Vega Baja | Bayamón | Aguada | Fajardo | Cidra |
| **9** | Mayagüez | Río Grande | Arecibo | Cabo Rojo | Mayagüez |
| **10** | Isabela | Aguada | Moca | Añasco | Cayey |

| Priority | Flooding | Landslides caused by Rains | Tsunamis | Evacuation Area causd by Tsunami | Increase in the Sea Level by the Effects of Climate Change | Fires |
|---|---|---|---|---|---|---|
| **1** | Juana Díaz | Barranquitas | Toa Baja | Toa Baja | San Juan | Ponce |
| **2** | Guayama | Orocovis | San Juan | San Juan | Cataño | Cabo Rojo |
| **3** | Naguabo | Cayey | Loíza | Loíza | Loíza | Juana Díaz |
| **4** | Aguada | Cidra | Mayagüez | Mayagüez | Carolina | Coamo |
| **5** | Salinas | Naranjito | Cataño | Carolina | Guaynabo | Yauco |
| **6** | Aibonito | Lares | Carolina | Cataño | Ponce | Guayama |
| **7** | Carolina | Utuado | Vega Baja | Arecibo | Salinas | Lajas |
| **8** | Ponce | Aibonito | Arecibo | Vega Baja | Guayama | San Germán |
| **9** | Mayagüez | Adjuntas | Aguada | Humacao | Toa Baja | Sabana Grande |
| **10** | Patillas | Corozal | Dorado | Bayamón | Humacao | Villalba |

The combination of the analysis previously done, will guide the State to identify hazards that the territory and its population are potentially expose. Also, to make an objective allocation of resources for mitigation activities, depending on the type and amount available. Programs and resources that have certain restrictions of use may be distributed according to the priority of each municipality and for each particular natural hazard. On the other hand, funds and resources that could be identified that are not pre-determined in their use are implemented within the overall priorities established for the State and according to the vulnerability of state critical facilities without taking into consideration the priority criteria by municipality. Later in this chapter the vulnerability of critical facilities is assessed.

## 2.4 Potential Losses Estimated of the Hazard Identified in the Local Mitigation Plans

As part of the integration process of local mitigation plans, were identified the estimated potential losses for risks by the municipalities in their plans. The variation in the used methods of calculations by the municipalities is a limitation in the data collection mechanism for estimating potential losses, should therefore be considered as general indicators of potential economic impacts on the identified jurisdictions.

Potential data losses that are included in this section were obtainde from local mitigation plans. Of the 64 plans provided by agencies in August, 2015, 58 included data from estimated potential losses. With the purpose of including the most information related to the loss estimates, in the 2011 PEMPN was identified the loss information of 13 additional municipalities for which the information for the review of 2016 PEMPN was not obtained. Thus the information of potential losses includes data provided by 71 of 78 municipalities tha make up Puerto Rico. In the

Appendix 2-D are included the estimated potential losses of the identified hazards in the Local Mitigation Plans.

The overall results of studies show that the estimated total cost of all identified potential natural hazards could represent a monetary loss to the country amounting to about $89.4 billion. This would represent a potential loss by municipality averaging about $1.3 billon (based on the 71 municipalities reported). The potential losses estimated for identified hazards in the Local Mitigation Plans, are:

| POTENTIAL LOSSES ESTIMATED | | |
|---|---|---|
| **HAZARDS** | | **LOSSES ESTIMATED** |
| Earthquakes | $ | 20,364,896,193 |
| Hurricanes /Tropical Storms | $ | 9,540,935,606 |
| Riverine or Coastal Flooding | $ | 13,973,507,123 |
| Landslides Caused by Rain or Earthquakes | $ | 14,392,269,438 |
| Liquefaction | $ | 1,487,854,382 |
| Tsunami | $ | 11,225,283,618 |
| Urban or Forest Fires | $ | 8,356,412,608 |
| Drought | $ | 6,007,843 |
| Coastal Erosion | $ | 85,538,548 |
| Storm Surge | $ | 653,111,065 |
| Hazards Caused by Humans | $ | 4,908,853,639 |
| Others | **$** | 4,430,185,569 |
| **TOTAL** | **$** | **89,424,855,632** |

## 2.5 Vulnerability Assessment of State Critical Facilities

The analysis of government critical facilities that are vulnerable to natural hazards is very important, as they represent the state's ability to adequately respond to emergencies and maintain essential services required by citizens. On the other hand, the current guides and regulations of

State Mitigation Plans establish to include an assessment of the vulnerability of critical facilities under the jurisdiction of the State Government. Many of these facilities can be critical to emergency operations, important government functions, housing vulnerable populations or provide continuity of important community services. The PEMPN defines a total of 21 types of critical facilities classified under two broad categories according to their service.

The categories and types of critical facilities are described below:

- **Category E – Emergency Response**

  E.1 Shelters (includes public and private, and other private)

  E.2 Regional Offices with Emergency Operations Centers of AEMEAD

  E.3 Police Stations

  E.4 Fire Stations

  E.5 Hospitals

- **Category I – Infrastructure**

  I.1 Water Filtration Plants – AAA

  I.2 Wastewater Treatment Plants – AAA

  I.3 Potable Water Tanks– AAA

  I.4 Pumping Stations– AAA

  I.5 Dams– AAA

  I.6 Hydrants– AAA

  I.7 Wells– AAA

  I.8 Airports, Ports and Heliports - AP

  I.9 Electric Power Substations – AEE

I.10 Bridges – DTOP

I.11 AM Radio Antennas

1.12 FM Radio Antennas

I.13 Radio Antenna Micro-Wave

I.14 TV Digital Antennas

I.15 Communication Towers - JRTC

I.16 Gas Stations

The information sources of data for critical facilities were obtained mainly from the Puerto Rico Planning Board. Some deficiencies were identified in these databases that included lack of detailed or description of the facility, some incomplete facility inventories, and imprecise location. On the other hand, some government agencies reported that buildings and facilities have not been incorporated into the inventory, either because they are newly constructed or because no electronic coordinates were provided or other information when completing the inventories. However, it is important to note that updating of the 2016 PEMPN has had more comprehensive databases than were available to update the 2011 PEMPN.

### 2.5.1 Inventory of Critical Facilities

The databases that were obtained from government agencies were integrated into the GIS analysis which allowed making a selection by category and integrate it with the analysis of natural hazards, to obtain a rank by localization. The range of vulnerability was determined by using a qualitative range of 1 to 5 reflecting the following ranges:

- Vulnerability Rank 1: Very Low
- Vulnerability Rank 2: Low

- Vulnerability Rank 3: Moderate
- Vulnerability Rank 4: High
- Vulnerability Rank 5: Very High

The vulnerability ranges by location were obtained from 11 assessed hazards. The hazards evaluated, included: Earthquake. Liquefaction, Landslide Caused by Earthquake, Seismic Wave, Strong Winds, Flooding, Landslide Caused by Rains, Flood Area Caused by Tsunami; Evacuation Area Caused by Tsunami and Wildfires. Once the different risks are combined, the level of combined risks is obtained. Through a geospatial process each of the geographical information levels corresponding to the infrastructure, are analyzed and assigned a value of risk that goes from outside or very low risk to very high risk.

In the Appendix 2-G it can be observed the tables of Individual and Composed Vulnerability of the State Critical Facilities, which are the result of the vulnerability analysis conducted for the categories of critical facilities evaluated. The collection and analysis of critical facilities in geographic information systems (GIS) was a mitigation strategy proposed in the 2011 PEMPN. Below provides a summary of the inventory of the State critical facilities throughout the Island that is currently available in the databases, and for which vulnerability assessments to hazards were conducted.

## INVENTORY OF THE STATE CRITICAL FACILITIES

| Type of Critical Facility | | Number of Assessed Facilities |
|---|---|---|
| **Category E: Emergency Management** | | |
| E.1 | Shelters (includes public and private, and other private) | 484 |
| E.2 | Regional Offices with Emergency Operations Centers of AEMEAD | 11 |
| E.3 | Police Stations | 98 |
| E.4 | Fire Stations | 84 |
| E.5 | Hospitals / Health Centers | 241 |
| **Category I: Infraestructure** | | |
| I.1 | Water Filtration Plants – AAA | 140 |
| I.2 | Wastewater Treatment Plants – AAA | 59 |
| I.3 | Potable Water Tanks– AAA | 2,168 |
| I.4 | Pumping Stations– AAA | 1,481 |
| I.5 | Dams– AAA | 50 |
| I.6 | Hydrants– AAA | 178 |
| I.7 | Wells– AAA | 514 |
| I.8 | Airports, Ports and Heliports - AP | 30 |
| I.9 | Electric Power Substations – AEE | 357 |
| I.10 | Bridges – DTOP | 2,271 |
| I.11 | AM Radio Antennas | 79 |
| I.12 | FM Radio Antennas | 93 |
| I.13 | Micro-Wave Radio Antenna | 1,749 |
| I.14 | TV Digital Antennas | 29 |
| I.15 | Communication Towers - JRTC | 986 |
| I.16 | Gas Stations | 1,691 |

The assignment of rank or prioritization of critical facilities in Puerto Rico on the basis of their vulnerability to natural hazards according to their location is intended to increase their resistance to specific natural hazards. State agencies participating in the Interagency

Mitigation Committee are responsible for the specific evaluation through field inspection using an assessment technique that has been modified according to current building codes in Puerto Rico.

As part of the updating of the 2016 PEMPN, were revised the forms proposed in the 2011 PEMPN to carry out field inspections of facilities that are located in a classification of high vulnerability. The field inspection forms use a qualitative ranking process aimed at identifying the structural vulnerability of the critical facility to floods, high winds, and seismic events. In the Appendix 2-F: *Guidelines for Vulnerability Assessment of Structures and Public Facilities*, provides forms for field inspections that should be used by State agencies to conduct structural inspections of critical facilities.

### 2.5.2 Estimated Potential Losses to State Critical Facilities

Updating the PEMPN has made progress in identifying and obtaining databases that make collection of the inventory of major facilities for the Island. Although the update of the PEMPN includes the most comprehensive databases on facilities owned or operated by the State, there is no centralized source of information that groups information together on estimated values of the structures, values of furnishings and equipment, years of construction and other essential data in the calculation of potential losses. Given the size and organizational complexity and extent of the infrastructure of Puerto Rico, together with the variety of natural hazards to which the country is exposed to, and the lack of the estimated value of the structures is not possible to make an accurate estimate of the potential losses of state critical facilities.

The estimate presented in this section is an extrapolation of the estimates by municipality that were discussed in previous sections. However, an approach procedure as such may reflect substantial inaccuracies. Below presented the average potential losses associated to the State critical facilities, using the data provided in 71 Municipal Mitigation Plans.

| AVERAGE OF POTENTIAL LOSSES ESTIMATED | | |
|---|---|---|
| **HAZARDS** | **AVERAGE*** | |
| Earthquakes | $ | 303,953,675 |
| Hurricanes /Tropical Storms | $ | 140,307,877 |
| Riverine or Coastal Flooding | $ | 208,559,808 |
| Landslides Caused by Rain or Earthquakes | $ | 266,523,508 |
| Liquefaction | $ | 87,520,846 |
| Tsunami | $ | 374,176,121 |
| Urban or Forest Fires | $ | 835,641,261 |
| Drought | $ | 2,002,614 |
| Coastal Erosion | $ | 7,776,232 |
| Storm Surge | $ | 130,622,213 |
| Hazards Caused by Humans | $ | 1,227,213,410 |
| Others | $ | 632,883,653 |
| **TOTAL** | **$** | **1,259,505,009** |

* To obtain the *average by hazard* it was taken into consideration the amount of municipalities that informed for that risk. For the total average it was taken into consideration the total estimates of the 71 municipalities which data was obtained. See Appendix 2-D.

With the purpose to address the shortcomings found to estimate the potential losses of critical facilities, will be required for government agencies to identify and group the information necessary to complete the analysis, as part of the implementation phase of the 2016 PEMPN. The methodology to be used for the evaluation of potential losses includes the following steps:

1. Selection of the critical facilities categories included in the analysis.
2. Location of critical facilities in a database of geographic information.

3. Overlay the location of critical facilities over the composed geographic layer of hazards.

4. Accounting critical facilities that are located in high hazard areas and identify them by type of facility.

5. Estimate the average loss of every type of installation.

6. Apply the average estimate of potential losses by facility type to the results of the analysis of facilities exposed to high levels of danger.

7. Calculate the potential losses by type of critical facility.

## 2.6. Severe Repetitive Loss

The grant program for structures that have suffered repetitive losses due to severe flooding effects (SRL) is authorized by the Federal law "Bunning-Bereuter-Blumenauer Flood Insurance Reform Act" of 2004. This program is created to reduce or eliminate long term risks of flooding to structures that have had severe repetitive losses that are insured under the National Flood Insurance Program.

Under the program, a repetitive loss is defined as a residential property that is covered under the insurance NFIP and that: 1) has had at least four insurance claim payments to the NFIP (including the structure and contents) over $5,000 each and that the cumulative amount of such claims exceed a total of $ 20,000, or 2) have made two claims payments (payments for the structure only) whose cumulative value of claims exceeds the market value of the structure.

According to these characteristics and data provided by the Office of the Governor's Authorized Representative, were identified the structures that have been included in the program

requirements and for whom assistance has been requested, for those who qualify. The breakdown of structures classified as "repetitive loss" by municipality is as follows:

**Repetitive Loss by Municipalities**

| MUNICIPALITIES | NO. UNITS | MUNICIPALITIES | NO. UNITS | MUNICIPALITIES | NO. UNITS |
|---|---|---|---|---|---|
| Adjuntas | 1 | Florida | 1 | Orocovis | 3 |
| Aguada | 1 | Guánica | 3 | Patillas | 20 |
| Aguadilla | 3 | Guayama | 19 | Peñuelas | 3 |
| Aibonito | 6 | Guayanilla | 14 | Ponce | 31 |
| Arecibo | 82 | Guaynabo | 25 | Quebradillas | 1 |
| Arroyo | 11 | Gurabo | 10 | Rincón | 2 |
| Barceloneta | 139 | Hatillo | 3 | Río Grande | 17 |
| Barranquitas | 2 | Hormigueros | 73 | Sabana Grande | 1 |
| Bayamón | 51 | Humacao | 47 | Salinas | 73 |
| Cabo Rojo | 27 | Jayuya | 3 | San Germán | 3 |
| Caguas | 22 | Juana Díaz | 15 | San Juan | 291 |
| Camuy | 1 | Juncos | 5 | San Lorenzo | 1 |
| Canóvanas | 53 | Lajas | 2 | Santa Isabel | 80 |
| Carolina | 33 | Las Piedras | 3 | Toa Alta | 2 |
| Cataño | 10 | Loíza | 41 | Toa Baja | 188 |
| Cayey | 18 | Manatí | 5 | Utuado | 4 |
| Ceiba | 8 | Maunabo | 3 | Vega Alta | 4 |
| Cidra | 3 | Mayagüez | 31 | Vega Baja | 373 |
| Comerio | 10 | Morovis | 1 | Villalba | 1 |
| Dorado | 27 | Naguabo | 20 | Yabucoa | 20 |
| Fajardo | 43 | Naranjito | 1 | Yauco | 8 |

Note: It does not include details of individual structures for confidentiality of information.

# CHAPTER 3: MITIGATION STRATEGY

The fundamental purpose of the PEMPN, as stated in Chapter 1, is to reduce the vulnerability and the loss of life and property generated by the impact of natural and unnatural risks, through the formulation of a mitigation strategy coordinated among the central government, municipalities, and citizens. Emergency or hazard management can be divided in measures before, during, and after the event. These measures are: planning (before), preparation (before), mitigation (before and after), response (during), and recovery (after). The most cost effective of these measures, in terms of reducing loss of life and property, are those that have an impact before the event occurs (planning, preparation and mitigation).

The hazard mitigation is a key *investment* of city development, because by reducing the vulnerability the benefits can outweigh the social impact and the post-disaster reconstruction costs. Experience has shown that the impact of hazards can be reduced, for this it is important to know about the risks, inform the citizens about the risks, and to identify structural and nonstructural measures for their mitigation. Taking into consideration the previous aspects, the goals, objectives, and actions to mitigate the effects of the identified hazards and the process in which they were determined are discussed in this Chapter.

## 3.1 Goals, Objectives, and Actions for Hazard Mitigation

The goals, objectives, and mitigation actions have different reaches, therefore it is important to distinguish the definition of these terms in the context of the planning process to mitigate hazards. The definitions are as follows:

- **Goals:** General guidelines that present the desired result to be achieved in the long term.
- **Objectives:** Describe the strategies that will be used to implement the established goals. The objectives are more specific than the goals; they define the way forward to achieve goals and their results should be quantifiable.
- **Actions:** Actions provide a detailed description of the specific tasks that are necessary to achieve the objectives.

### 3.1.1 Review of Goals, Objectives, and Proposed Actions of the 2011 PEMPN

The goals, objectives, and actions reflect the long term vision proposed by the State to achieve effective hazard mitigation and, whenever possible, reduce loss of life and property that may result as a consequence of hazards. The process of reviewing and updating the 2016 PEMPN included the discussion and evaluation of goals, objectives and mitigation actions proposed in the 2011 PEMPN, with the AEMEAD mitigation staff. The purpose of this evaluation was to determine the compliance of the goals, objectives, and mitigation actions and to determine their continuity in the 2016 PEMPN.

The result of the evaluation is as follows:

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | *Totally completed* | *Partially completed* | *Not completed* |
| ***Goal 1: Develop a more resistant Puerto Rico to disasters, reducing vulnerability to future natural hazard events.*** | | X | |
| ***Objective 1.1*** Improve efforts to reach the public with information on natural hazards and sustainable development initiatives. | X | | |
| ***1.1.1*** *Action*: Prepare and distribute simple construction drawing models that incorporate measures to protect against strong winds, landslides and earthquakes in the informal construction of rural single family homes. | | | X |
| ***1.1.2*** *Action*: Distribute to key agencies in the Central Government, Municipal Government and organizations, FEMA publications that address hazard mitigation and sustainable development topics, especially on flooding, landslides, hurricanes, and earthquakes. | X | | |
| ***1.1.3*** *Action*: Develop partnerships with the media to disseminate information to the general public on the concepts of hazard mitigation and sustainable development, especially for floods, landslides, hurricanes, and earthquakes. | X | | |
| ***Objective 1.2*** Develop formal mechanisms for distributing information to government agencies, universities, professional associations and the private sector on natural and man-made hazards, and their vulnerability. | X | | |
| ***1.2.4*** *Action*: Develop mechanisms to collect, evaluate, and assess the vulnerability of state critical facilities exposed to floods, hurricanes, landslides, and earthquakes. | | X | |
| ***1.2.5*** *Action*: Provide appropriate state agencies with access to hazards maps and information on vulnerability by digital and written reports, and the Internet, mainly flooding and landslides. | | X | |

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | ***Totally completed*** | ***Partially completed*** | ***Not completed*** |
| **1.2.6** *Action*: Publish on the AEMEAD website (http://www.gobierno.pr/AEMEAD/) updated information on natural and man-made hazards and their vulnerability and mitigation, to educate and disseminate information to the general public, professional associations and schools, among others. | X | | |
| ***Objective 1.3*** Provide information for the purpose of increasing knowledge and awareness of architects, planners and engineers, among others, to the concepts of hazard mitigation and sustainable development. | | X | |
| ***1.3.7*** *Action*: Conduct workshops with the Puerto Rico College of Engineers and Surveyors, the Puerto Rico College of Architects, and the Puerto Rican Planning Society. | | X | |
| ***1.3.8*** *Action*: Coordinate efforts with educational institutions to incorporate the topics of natural and technological hazard mitigation in the curricula of architecture, engineering and planning at the undergraduate and graduate levels. | | X | |
| ***Objective 1.4*** Encourage municipalities to incorporate the concepts of hazard mitigation developed in their Local Mitigation Plans into their existing Land-Use Plans and in new plans. | X | | |
| ***1.4.9*** *Action:* Promote the use of zoning options for areas adjacent to urban areas and low risk natural areas, thus enabling a wide range of population density and different housing structures. | | X | |
| ***1.4.10*** *Action*: Encourage more restrictive requirements in the zoning of future areas of population growth and at risk for flooding, landslides, earthquakes, and hurricanes. | | X | |
| ***1.4.11*** *Action*: Promote the implementation of more stringent zoning requirements for areas of the municipalities that are classified as High and Very High | | X | |

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | ***Totally completed*** | ***Partially completed*** | ***Not completed*** |
| Vulnerability to natural hazards. | | | |
| ***Goal 2: Strengthening the capacity of state government agencies to incorporate principles of natural hazard mitigation and sustainable development in their daily operations.*** | | X | |
| ***Objective 2.1*** Ensure that planning and design criteria for the mitigation of natural hazards are incorporated into new infrastructure projects and other public facilities. | | X | |
| ***2.1.12*** *Action*: Promote the factors that are considered natural hazards mitigation in the design and construction of major roads and bridges, taking into account the primary and secondary impacts on the environment. | | X | |
| ***2.1.13*** *Action*: Develop specifications in the documents to be included in public auctions for new infrastructure and construction of new public facilities that require that design consultants direct their efforts towards mitigation of natural hazards. | | | X |
| ***2.1.14*** *Action*: Incorporate criteria for natural hazard mitigation as an element of assessment of project eligibility for Five-Year State Capital Improvement Program. | | X | |
| ***Objective 2.2*** Continue efforts to integrate natural hazard analysis during the interagency review process for public and private sectors development projects. | | X | |
| ***2.2.15*** *Action*: To ensure that the Planning Board of Puerto Rico improves the environmental review of major land development projects to include the study of natural hazards. | | X | |
| ***2.2.16*** *Action*: Develop a mechanism to review development projects in coastal areas. This mechanism will focus on the criteria of the multiple objectives of planning for hazard mitigation, sustainable development and environmental protection. This action | | X | |

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | *Totally completed* | *Partially completed* | *Not completed* |
| should be carried out by the Planning Board, along with the Department of Environment and Natural Resources and PREMA (AEMEAD). | | | |
| ***2.2.17*** Propose legislation to formalize the evaluation of proposed development projects for their potential exposure to natural hazards as part of the permit process. | | X | |
| ***Objective 2.3*** Provide information to the programs and departments of State Agencies for the purpose of increasing awareness and sensitivity toward the concepts of hazard mitigation and sustainable development. | X | | |
| ***2.3.18*** *Action*: Increase the number of key positions and wages of skilled labor, such as architects, engineers and planners, within state agencies in order to encourage their retention. | | X | |
| ***2.3.19*** *Action*: Increase the capacity and tools for employees who work with the evaluation of permits to ensure greater compliance with building codes across the Island. | | X | |
| ***2.3.20*** *Action*: Develop training programs for the team of professionals who investigate and evaluate projects, with emphasis on the consideration of hazard mitigation concepts in monitoring these projects. | | X | |
| ***Goal 3: Improve the ability of the State Government to restore critical facilities and critical infrastructure and ensure continuity of government services after a natural disaster.*** | | X | |
| ***Objective 3.1*** Reduce the vulnerability of existing critical facilities and essential infrastructure. | | X | |
| ***3.1.21*** *Action*: Develop conceptual design plans to restore or relocate the state's critical facilities of priority and identify funding sources prior to the occurrence of a disaster, such as FEMA PDM competitive grant matched with local funds. | | | X |

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | *Totally completed* | *Partially completed* | *Not completed* |
| ***3.1.22*** *Action*: Identify specific restoration projects or relocation of state's critical facilities that can be activated with HMGP funds from FEMA after a disaster. | | X | |
| ***3.1.23*** *Action*: Evaluate and implement innovative measures to obtain funds for natural hazard mitigation planning and mitigation projects throughout Puerto Rico, including, but not limited to: additional legislative appropriations; line items in the annual budget for emergency management of state agencies; sources of private funding; taxes on hazardous areas; fees for development permits or new constructions in coastal areas at risk of flooding, 100 year flood risk areas, and other areas defined as high risk areas. | | X | |
| ***Objective 3.2*** Improve the ability of the State Government to restore and give continuity to public services after a natural disaster. | X | | |
| 3.2.24 *Action*: Each state agency participating in the Interagency Mitigation Committee will complete or update its mitigation plan and will include specific measures to ensure continuity of services offered. | X | | |
| ***Goal 4: Provide support at the municipal level, for developing and updating effective plans to mitigate natural hazards, mitigation activities and technical assistance.*** | X | | |
| ***Objective 4.1*** Ensure effective coordination between AEMEAD and municipalities in planning for natural hazard mitigation. | X | | |
| ***4.1.25*** *Action*: Ensure the municipality has access to individual or composite natural hazard maps of its territory and make presentations on the guidelines for the development of mitigation plans for natural hazards. | | X | |
| ***4.1.26*** *Action*: Provide ongoing support to municipalities to implement programs of natural hazard mitigation. | X | | |

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | *Totally completed* | *Partially completed* | *Not completed* |
| ***4.1.27*** *Action*: Provide continuous access through the Internet on hazard mitigation and technical assistance in implementing and updating the Municipal Mitigation Plans. | X | | |
| ***4.1.28*** *Action*: Maintain a continuous process of gathering information about the experience in the implementation of mitigation plans and monitoring Municipal updates for integration into future revisions of the PEMPN. | X | | |
| ***Objective 4.2*** Ensure funding and technical assistance to municipalities during the process of development, revision and implementation of natural and man-made hazard mitigation plans. | X | | |
| ***4.2.29*** *Action*: Use existing funds from the PDM to offer support to the development of municipal plans for mitigation of natural hazards. | X | | |
| ***4.2.30*** *Action*: Obtain State Government funding needed to complete mitigation plans at the municipal level to the municipalities who have not completed them and for future updating and revision through additional legislative action and PDM funds. | | | X |
| ***4.2.31*** *Action*: Make maximum use of HMGP funds for developing separate plans at the municipal level, where there are natural events and disasters declared by the Federal Government. | X | | |
| ***Goal 5: Strengthen the capacity of the AEMEAD to effectively manage hazard mitigation programs of FEMA and other agencies.*** | X | | |
| ***Objective 5.1*** Continue and strengthen efforts to integrate the processes of hazard mitigation planning in the municipalities. | X | | |
| ***5.1.32*** *Action*: Continue efforts to integrate the elements of natural hazard mitigation in local land-use plans. | X | | |
| ***5.1.33*** *Action*: Initiate coordination with the coastal areas management team to strengthen implementation of the | | X | |

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | *Totally completed* | *Partially completed* | *Not completed* |
| natural hazard mitigation objectives of the State Mitigation Plan for coastal communities. | | | |
| ***5.1.34*** *Action*: Continue with the implementation of legislative requirements for state agencies to continue to update their mitigation plans so as to cover natural hazards such as those caused by humans. | | X | |
| ***Objective 5.2*** Continue to strengthen the capacity to implement mitigation projects. | X | | |
| ***5.2.35*** *Action*: Refine eligibility criteria established for mitigation actions of multiple natural hazards. | X | | |
| ***5.2.36*** *Action*: Institutionalize a cost-effective methodology for reviewing HMGP projects, consistent with Circular OMB A-94 and the current guidelines of FEMA. | X | | |
| ***5.2.37*** *Action*: Strengthen the capacity of the AEMEAD to conduct compliance reviews required by NEPA and NHPA on HMGP projects. | X | | |
| ***Objective 5.3*** Manage FEMA mitigation programs effectively. | X | | |
| ***5.3.38*** *Action*: Improving the designated deadlines for submitting applications for HMGP, FMA and PDM funding so that proposals are complete and technically efficient. | X | | |
| ***5.3.39*** *Action*: Provide environmental reviews and cost-effectiveness analysis that are accurate and defensible. | X | | |
| ***5.3.40*** *Action*: Submit quarterly financial and progress reports that are accurate and timely delivered. | X | | |
| ***5.3.41*** *Action*: Complete mitigation projects funded by HMGP and other mitigation projects within budget and within set time. | X | | |
| ***Objective 5.4*** Refine the administrative procedures for mitigation programs to document project | | X | |

| GOALS, OBJECTIVES AND MITIGATION ACTIONS 2011 PEMPN | ESTIMATED LEVEL OF COMPLIANCE | | |
|---|---|---|---|
| | *Totally completed* | *Partially completed* | *Not completed* |
| completion and cost-effectiveness of projects. | | | |
| ***5.4.42*** *Action*: Develop a management tool database and procedures for monitoring the progress of mitigation projects from inception to execution. | | X | |
| ***5.4.43*** *Action:* Create formal processes and methodologies to calculate and document the actual loss avoided by each mitigation project. | | X | |
| ***5.4.44*** *Action*: Create and keep a permanent record of the effectiveness of mitigation projects, to periodically add avoided costs of mitigation projects completed throughout Puerto Rico. | | | X |

In synthesis, the analysis regarding the completion of the goals, objectives, and proposed actions of the 2011 PEMPN determined that of the five established *Goals*, 40% were fully completed and 60% were partially completed; of the 15 *Objectives*, 67% were fully completed and 33% were partially completed;  and of the 44 proposed *Actions*, 39% were fully completed, 50% were partially completed, and 11% were not completed.  It can be noted that, in most cases, the goals, objectives and actions that were fully completed are all related with: distribution of information to the agencies and general public regarding hazards, and offering guidance and technical assistance to municipalities in the development of Local Mitigation Plans and compliance with program management and funds availability for the development of mitigation plans or projects.  Furthermore, the goals, objectives and actions that were partly completed are related to: the development or use of available mechanisms to assess the vulnerability of structures exposed to hazards, coordination among agencies, professional organizations and interest groups to analyze and develop the projects, promotion of more restrictive requirements in

vulnerable areas of risk, and integration of hazard analysis and mitigation actions during interagency assessment of the proposed public and private projects. Regarding the goals, objectives and actions that were not completed, it was observed that they are related to more specific strategies, such as: preparation of construction model plans that incorporate hazard protection measures, the development of mitigation requirements to be incorporated in auction documentation and the development of tools to determine the effectiveness of the completed mitigation projects. Once the analysis of compliance of goals, objectives and mitigation actions of the 2011 PEMPN was completed, the need to strengthen the relationship between agencies, professional organizations and other interest groups was identified, since most goals, objectives and actions that impacted or had need of resources aside the AEMEAD were those identified as partially completed or not completed.

### 3.1.2 Goals, Objectives, and Mitigation Actions of the 2016 PEMPN

Generally, there is a sense of resignation in the face of hazard events because they are inevitable. The effect of this "resignation" is the minimization of the importance of adopting mitigation measures. Although in some cases a hazard event cannot be prevented, changing this way of thinking is crucial to reduce the potential impact of hazards, and the loss of life and property through the development and implementation of mitigation measures.

Currently, there are multiple studies, information and analysis regarding various natural and unnatural hazards. There are also early warning and alert systems available (e.g. Tsunamis and Hurricanes) that are intended to reduce economic, life, and property losses.

In addition, there are many tools to analyze the possible impact of hazards and determine the vulnerability to which we are exposed. Among them:

- **Geographic Information Systems**

  It allows the management of multiple data in different formats (e.g. Scanned maps, satellite images, and statistical or census data) and integrates normally dispersed information and analysis to produce "new" information according to the needs.

- **HAZUS**

  Analysis model developed by the Federal Emergency Management Agency (FEMA) to estimate the physical, social and economic impact on a community of an earthquake, flood or hurricane. HAZUS combines mathematics, science and engineering with the Geographic Information System to estimate life and property losses and represent them on a map.

- **Risk Maps**

  Maps depicting the extent or threat of a particular risk (e.g. Flood maps).

As noted, the information and methods needed to analyze and reduce the effects of hazards exist. The correct use of the tools available to mitigate hazards is the responsibility of the various sectors that make up a society. In Puerto Rico, in addition to the AEMEAD and the Caribbean Area Office of FEMA, the sectors related to the management and mitigation of hazards are: Office of Governor's Authorized Representative, Puerto Rico Planning Board, Permits Management Office, Department of Natural and Environmental Resources, Office of Historic Preservation, Environmental Quality Board, U.S. Army Corps of Engineers, Puerto Rico Seismic Network, Puerto

Rico Coastal Zone Management Program, Fire Department, National Weather Service, Environmental, Scientific, and Engineering Organizations, the general public and others that can be identified. Each sector has its own interests and perspectives, which can bring difficulties in the process of implementing mitigation measures. Identifying the need and measures to strengthen relationships within government agencies, professional organizations and other interest groups is essential for the implementation of the mitigation strategy. In addition to information and hazards analysis, early warning systems, analysis tools and sectors related to management and hazard mitigation, Puerto Rico has legal, fiscal and financial resources that evidence the state's ability to obtain the expected results regarding hazard mitigation. The factors on the ability of state mitigation will be discussed in the next chapter.

Taking into consideration the variety of factors that affect the management and mitigation of hazards previously discussed, the goals, objectives and mitigation actions of the 2016 PEMPN presented below were discussed with the AEMEAD staff assigned to review the PEMPN. For the development of the goals, objectives and mitigation actions proposed, those presented in the 2011 PEMPN were used for the purpose of giving continuity to the efforts and addressing those which for various reasons are partially completed or not completed. The necessary changes were made to address the results of the analysis of compliance and new information available on: natural hazards, analysis tools and changes in relevant laws, among others aspects.

The original formulation of mitigation actions, as described in the 2011 PEMPN, responded to a procedure based on seven criteria, known as STAPLEE evaluation, that

are described in FEMA 386-3 Guide "Developing the Mitigation Plan". These criteria were taken into consideration in formulating the mitigation strategy of the 2016 PEMPN. The criteria for mitigation actions were as follows:

- *Social:* Has social acceptance, studying the adverse effects on certain segments of the population.
- *Technical*: Be technically feasible; that offers long-term solutions and has minimal secondary impacts.
- *Administrative:* Have the staffing, funding, and operational and maintenance requirements necessary to implement the actions.
- *Political:* Have the political support to carry them out, the indicated agencies responsible for implementing the actions, and public support.
- *Legal*: Verify whether the mitigation action is in accordance with the state, federal or municipal government laws.
- *Economic*: Establish the costs of mitigation action, its benefits, and identify the need for external funding to implement the action.
- *Environmental:* Study and anticipate the impact on land, water quality, endangered species, and areas sensitive to fluctuations in the environment; the mitigation action should be consistent with federal environmental laws.

In addition to the STAPLEE review criteria for the formulation of goals, objectives and mitigation actions, the integration of a hazard mitigation planning process was identified as a fundamental aspect, so that mitigation is not an isolated process from others aspects regulating public policy and development in Puerto Rico. The review process and identification of goals, objectives and mitigation actions for the 2016 PEMPN resulted in the formulation of three (3) goals, six (6) objectives and 30 mitigation actions.

## GOALS, OBJECTIVES AND MITIGATION ACTIONS OF THE 2016 PEMPN

### GOAL 1

***Develop a more resilient Puerto Rico to disasters, reducing vulnerability to future natural hazard events.***

**Objective 1.1:** *Strengthen the Central Government's capacity to mitigate natural and unnatural hazards.*

*Action 1.1.1*

Collect and distribute to State Government agencies, up-to-date information regarding hazards that affect Puerto Rico, vulnerability, and alternatives on how to mitigate them in order to increase the knowledge of its staff.

*Action 1.1.2*

Foster and encourage the State Government agencies to publish on their websites the official information received regarding hazards affecting Puerto Rico, vulnerability and alternatives on how to mitigate them.

*Action 1.1.3*

Advise State Government agencies to incorporate hazard mitigation principles into their routine operations.

*Action 1.1.4*

Require from each State Agency participating in the Interagency Mitigation Committee to complete or update their risk analysis, identification of hazards and potential projects to mitigate risk vulnerability in order to reduce the vulnerability of the structures of the agencies.

### *Action 1.1.5*

Identify, evaluate and assess the hazard vulnerability of state critical facilities, emphasizing on the dangers of floods, hurricanes, landslides and earthquakes, in order to identify mitigation alternatives (e.g. Improvements or relocation of structures) to reduce or eliminate vulnerabilities. Particularly it is necessary to:

- Promote the importance of maintaining updated vulnerability analysis of structures and facilities of state agencies that regularly are not associated with the hazard mitigation process. An example could be the Department of Agriculture, whose industry is regularly struck by floods, droughts and hurricanes; and the Puerto Rico Tourism Company, whose facilities and attractions located in coastal or forested areas are exposed to the impact of various hazards. Distribute the analysis results with agencies related to the planning and mitigation processes, and identify measures to mitigate the vulnerability of these sectors.
- Promote the importance of maintaining updated vulnerability analysis of the critical infrastructure of Puerto Rico, such as: Electric Power Authority, Aqueduct and Sewer Authority, Department of Transportation and Public Works, and Telecommunications Regulatory Board. Distribute the analysis results with agencies related to planning and mitigation processes and identify measures to mitigate the vulnerability of the critical infrastructure.

### *Action 1.1.6*

Identify specific restoration or relocation projects of state critical facilities that can be developed prior to the occurrence of the disaster with funding sources such as Federal Highway and FEMA-PDM matched with local funds, or those that can be activated after a disaster with funds from FEMA HMGP.

*Action 1.1.7*

Increase the number of qualified personnel, such as architects, engineers and planners within state agencies to assess and manage programs and projects that impact the process of hazard mitigation.

***Objective 1.2:*** *Strengthen the capacity of the municipal government to mitigate natural and unnatural hazards.*

*Action 1.2.8*

Provide the municipalities with continued access to updated information on the hazards affecting Puerto Rico, mitigation measures and analysis tools available through the Internet and/or database, in order to increase knowledge of its staff and to provide tools that can be used to analyze the vulnerability of its territory.

*Action 1.2.9*

Provide technical assistance to municipalities during the proposal preparation process to obtain funding for the development, revision and implementation of natural and unnatural hazard mitigation plans and projects.

*Action 1.2.10*

Offer training to municipalities on the preparation, adoption and implementation of the Municipal Mitigation Plans and on the development of mitigation activities and projects.

*Action 1.2.11*

Advise the municipalities to integrate the hazard mitigation measures stated in their Municipal Mitigation Plans into other plans, such as the Land-Use Plans.

***Objective 1.3:*** *Strengthen the capacity of non-governmental organizations and the general public to mitigate natural and unnatural hazards.*

*Action 1.3.12*

Increase the efforts and mechanisms to inform non-governmental organizations and citizens on natural and unnatural hazards, mitigation alternatives and response guides to dangers, through: agencies and municipal websites, social networks, workshops or educational campaigns and the development of partnerships with the media to disseminate information, among others that can be identified.

*Action 1.3.13*

Prepare and distribute simple design plans of construction models for single family homes that incorporate protection measures against strong winds, landslides and earthquakes, and promote the importance of including these measures in housing construction.

*Action 1.3.14*

Provide information on hazard mitigation measures related to the construction process to professional organizations such as planners, architects, surveyors and engineers, among others, in order to increase their knowledge in the area, including promoting mitigation measures from the initial stages of development of plans and public and private projects, and emphasize the importance of adhering to building codes applicable in Puerto Rico.

## GOAL 2

***Strengthen the capacity of the GAR and AEMEAD to effectively manage the hazard mitigation programs available.***

**Objective 2.1:** *Ensure the development and implementation of plans, projects and mitigation programs.*

*Action 2.1.15*

Continue with the function of safeguarding the compliance with the funds allocated for the development and implementation of mitigation measures and projects.

*Action 2.1.16*

Identify and assess the availability of federal, state and private funds to plan and develop hazard mitigation projects throughout Puerto Rico.

*Action 2.1.17*

Maintain a communication process with the agencies, municipalities and organizations to obtain information about the implementation status of the plans and mitigation projects and integrate them into future revisions of the PEMPN.

*Action 2.1.18*

Coordinate and carry out training activities through the Office of the GAR and AEMEAD, on how to effectively use the FEMA-BCA (*Benefit Cost Analysis*) computer program for the cost-benefit analysis of mitigation projects. These training activities may be offered to municipalities and state agencies staff responsible of preparing federal proposals, for them to become more specialized in the process of BCA.

## GOAL 3

***Strengthen the relationship between agencies, municipalities and organizations to mitigate natural and unnatural hazards.***

**Objective 3.1:** *Develop and maintain partnerships across sectors that affect the process of hazard mitigation.*

*Action 3.1.19*

Establish a system for collecting historical data of past events that are needed when preparing the BCA of mitigation projects included in the municipal plans. Share relevant information on vulnerability and hazard analysis in Puerto Rico that different sectors work directly or indirectly related to the hazard mitigation processes in order to disseminate the information and systematically promote the need for and benefits of mitigating such hazards.

*Action 3.1.20*

Promote the Hazard Mitigation and Adaptation to Climate Change Guidelines as stated in the Puerto Rico Land-Use Plans (PUT), complying with the provision of the PUT that states that all planning tools, effective November 19, 2015, should include mitigation and adaptation to climate change.

*Action 3.1.21*

Coordinate efforts with educational institutions to incorporate topics of natural and technological hazards mitigation in the architecture, engineering and planning curriculum.

*Action 3.1.22*

Establish agreements with educational institutions to gather information related to research on analysis of natural and unnatural hazards, mitigation strategies and analysis tools.

*Action 3.1.23*

Maintain communication and coordination with the Office of the Coastal Zone Management Program, Water Resources and Climate Change Program ascribed to the Department of Natural and Environmental Resources, National Weather Service, Aqueduct and Sewer Authority, and other relevant agencies to increase safety and guidance to coastal communities to integrate actions that are identified and can be developed to mitigate the effects of climate change. Similarly, work with the communities experiencing the effects of droughts, fires or other risks caused by the projected climate change.

***Objective 3.2:*** *Use ordination tools, standards, laws, and applicable analysis tools and preparation exercises available in different agencies, municipalities or organizations to mitigate the identified hazards.*

*Action 3.2.24*

Work with the municipalities and agencies related to the process of planning, evaluation and approval of projects, so they integrate hazard analysis as a requirement for project evaluation or public and private developments and therefore avoid the effect of the vulnerability of certain hazards. In addition, use the regional planning instruments as stated in the Land-Use Plan of the Puerto Rico Planning Board and Territorial Ordinance Plans of the Autonomous Municipalities as hazard mitigation mechanisms.

*Action 3.2.25*

Promote the use and transfer of tools and analysis technologies available, such as GIS and HAZUS, to identify vulnerable areas or sectors, estimate the physical, social and economic impacts that the hazards may cause, and define mitigation actions.

*Action 3.2.26*

Strengthen the system sensors and early warning risk systems at the State and Municipal level, as a preparedness measure and mitigate the potential impact of a hazardous event to reduce or eliminate loss of life.

*Action 3.2.27*

Promote the participation of the coordinators of the State Interagency Mitigation Committee in the available processes, such as: public hearings and be an active member of committees and working groups to analyze, comment and ensure that mitigation action are taken into consideration or integrated in the projects, plans or other initiatives proposed and that may affect the vulnerability to hazards.

*Action 3.2.28*

Promote the acquisition of flood insurance in all flood-prone communities throughout the island, of the National Program Flood Insurance coordinated by the Floodplain Management under the Planning Board, as well as to promote practices to mitigate floods in these communities in order to reduce losses and associated costs to this hazard.

*Action 3.2.29*

Promote the participation of the agencies, municipalities, organizations and citizens in the planning process, drills and preparation exercises for the possible impact of earthquakes, floods and tsunamis, among others, to identify deficiencies that when corrected before the possible hazard incident occurs will become mitigation strategies; practice the recommended steps to follow during the incident and ascertain the citizenship and agencies readiness related to mitigation and management of hazards and emergencies.

*Action 3.2.30*

Promote the participation of communities, practitioners, academics and religious groups, among others, in the Community Emergency Response Teams (CERT) to acquire basic knowledge on how to respond in an emergency, identify structural and nonstructural hazards, and prepare mitigation and action plans.

As noted, the majority of the proposed mitigation actions are nonstructural measures aimed to the maximum use of the resources and tools available and do not impose the costs associated with structural mitigation measures. In Appendix 5-D: Summary of Municipal Mitigation Plans can be noted structural measures proposed by municipalities to mitigate the impacts of the identified hazards in their territory. Also, the hazard mitigation projects that were implemented by the agencies or organizations, and currently in process or been completed during the term of the 2011 PEMPN, are indicated below.

## 3.2 Projects Related to the Mitigation Process

Puerto Rico has benefited from many internal and external resources that have facilitated the development and implementation of mitigation efforts on the Island. Institutions related to the sectors of education and urban development, among others, have been working with federal and state governments to promote and provide tools that help to make Puerto Rico more disaster resistant. State and Federal Government agencies and entities, such as AEMEAD, Department of Natural and Environmental Resources, Planning Board, University of Puerto Rico, Puerto Rico Seismic Network, FEMA, United States Army Corps of Engineers, United States Geological Survey, National Oceanic Atmospheric Administration, and National Resources Conservation Service have contributed with many technical and financial resources.

The achievements of structural and non-structural initiatives have been documented since the late '70s. During the decades of the '80s and '90s, structural mitigation projects in Puerto Rico decreased and/or eliminated damages to infrastructure caused by flooding. The projects are focused on developing more resilient channels and pumping systems. In addition, non-structural initiatives were developed; for example, the Island continued to promote the National Flood Insurance Program (NFIP) in flood-prone communities, the creation of maps of areas prone to flooding, regulation aimed at building more resistant housing, and development of the *Puerto Rico Flood Hazard Mitigation Plan*. Also, the *Coastal Zone Management Program* was developed, which assesses problems and plans activities for the mitigation of damages from coastal flooding. One result of these activities was the adoption of *Planning Regulation Number 13: Areas Susceptible to Flooding* and the publication of several studies of coastal hazard mitigation.

Other non-structural initiatives undertaken are aimed at mitigating the risk to damage from earthquakes. Vulnerability assessments were completed in the more urbanized areas of the Island: San Juan, Ponce, Aguadilla and Arecibo. The College of Engineers and Surveyors of Puerto Rico recommended the development of regulations for construction of earthquake resistant structures and the *Earthquake Safety Committee* was established. Vulnerability studies to hurricanes were completed and economic damage estimates models were developed for the San Juan Metropolitan Area. These studies developed by the University of Puerto Rico, Mayaguez Campus, contributed to the development of the Emergency Evacuation Plan for the Metropolitan Area.

Some of these initiatives were completed during the period of the 2008 PEMPN, such as the maps that identify flood risk areas in Puerto Rico. These maps were prepared by the FEMA program: NFIP, and are known as the Flood Insurance Rate Maps (FIRM). These identify the floodplain for one percent (1%) chance of a flood occurring each year, known also as the storm with 100-year recurrence, and the floodplain for the 500-year storm or 0.2% chance of occurrence.

Some projects implemented as part of the 2011 PEMPN, those that are ongoing or that support the state and local mitigation capacity; and goals, objectives, and actions established to mitigate the risks identified in the 2016 PEMPN, are presented below.

## PROJECTS CONDUCTED DURING THE 2011 PEMPN

| *Projects* | *Agencies or entities* | *Hazard to mitigate* |
|---|---|---|
| Workshops and presentations on HAZUS-MH Puerto Rico to train the staff of the Puerto Rico Planning Board and the municipalities. The workshops include: HAZUS, basic GIS and basic GPS | ▪ JP / Information Systems Area | ▪ Earthquakes<br>▪ Floods<br>▪ Hurricanes |
| Update of the AEMEAD Emergency Operations Plan | ▪ AEMEAD | ▪ All hazards |
| Update of OMME operational plans | ▪ OMME<br>▪ AEMEAD | ▪ All hazards |
| Issuance of the following Executive Orders to protect the environment:<br>**OE-2013-019**<br>To order the Department of Natural and Environmental Resources to conduct the Maritime Terrestrial Zone Delineations.<br>**OE-2013-018**<br>An order to quantify the emissions of greenhouse gases in Puerto Rico and the development of a plan for reducing these emissions in order to approach the carbon neutral goal.<br>**OE-2013-017**<br>An order to create the Sustainability of Puerto Rico Action Committee<br>**OE-2013-016**<br>To order the agencies in charge of infrastructure to develop a study on the vulnerability of public infrastructure due to climate change and the plans to face study findings.<br>**OE-2013-015**<br>To order the Puerto Rico Planning Board to finish and adopt the Land-Use Plan of Puerto Rico | ▪ Office of the Governor / La Fortaleza (The Fortress) | ▪ All hazards |

| ***Projects*** | ***Agencies or entities*** | ***Hazard to mitigate*** |
|---|---|---|
| Develop a Vulnerability Analysis and Adaptation to Climate Change Plan as required by Executive Order 2013-016. The government agencies or instrumentalities who will perform the analyzes and plans, are:<br>▪ Public Housing Program<br>▪ State Emergency Management and Disaster Administration Agency<br>▪ Aqueduct and Sewer Authority<br>▪ Highways and Transportation Authority<br>▪ Public Buildings Authority<br>▪ Electric Power Authority<br>▪ Ports Authority<br>▪ Lands Authority<br>▪ Maritime Transport Authority<br>▪ Public-Private Partnership Authority<br>▪ Infrastructure Financing Authority<br>▪ Authority for the Financing of the Infrastructure of Puerto Rico<br>▪ Tourism Company<br>▪ Department of Education<br>▪ Department of Health<br>▪ Department of Natural and Environmental Resources<br>▪ Department of Transportation and Public Works<br>▪ Department of Agriculture<br>▪ Department of Housing<br>▪ Environmental Quality Board<br>▪ Planning Board<br>▪ Permit Management Office | ▪ DRNA<br>▪ Agencies that were requested to work on the Vulnerability Analysis and the Adaptation Plans | ▪ All hazards |
| Puerto Rico Land-Use Plan, as required by Executive Order OE-2013-015, was completed. | ▪ JP | ▪ All hazards |
| Constitution of the Council of Climate Change of Puerto Rico (CCCPR) in order to assess the vulnerability of Puerto Rico and recommend strategies to respond to those changes. The | ▪ DRNA<br>▪ CCCPR<br>▪ NOAA<br>▪ USGS | ▪ Climate change |

| *Projects* | *Agencies or entities* | *Hazard to mitigate* |
|---|---|---|
| CCCPR is formed by four working groups: Geophysical and Chemical Scientific Knowledge (WG1); Ecology and Biodiversity (WG2); Society and Economy (WG3); and Communicating Climate Change and Coastal Hazards (WG4). | ▪ AEMEAD<br>▪ UMET<br>▪ RSPR<br>▪ UPRM | |
| Completion and publication of the report: *State of the Puerto Rico Climate: Assessment of Socio-ecological Vulnerabilities 2010-2013* | ▪ DRNA<br>▪ CCCPR<br>▪ NOAA<br>▪ USGS<br>▪ AEMEAD<br>▪ UMET<br>▪ RSPR<br>▪ UPRM | ▪ Climate change |
| Completion and publication of the report: *The State of the Puerto Rico Climate: Adaptation Strategies and Coastal Risk Prevention 2014* | ▪ DRNA<br>▪ CCCPR<br>▪ NOAA<br>▪ USGS<br>▪ AEMEAD<br>▪ UMET<br>▪ RSPR<br>▪ UPRM | ▪ Climate change |
| TsunamiReady: National Weather Service program that promotes risk preparedness in case of a tsunami.<br>▪ The 44 coastal municipalities of Puerto Rico completed the requirements of the TsunamiReady program and have Tsunami eviction maps. | ▪ RSPR<br>▪ Municipalities | ▪ Tsunamis |
| StormReady: A program that addresses the handling of tropical storms and hurricanes. Among the municipalities that have met the requirements of the StormReady program are: Mayagüez, Manatí, Dorado, Toa Baja, Aguadilla, Carolina and Vega Baja. | ▪ RSPR<br>▪ Municipalities | ▪ Hurricanes |
| Update of Municipal Mitigation Plans | ▪ Municipalities<br>▪ FEMA | ▪ All hazards |

| *Projects* | *Agencies or entities* | *Hazard to mitigate* |
|---|---|---|
| | ▪ GAR<br>▪ AEMEAD | |
| Preparation of the Adaptation to Climate Change Plans in the municipalities of Culebra, Dorado and Rincón | ▪ DRNA<br>▪ CCCPR<br>▪ Municipalities | ▪ Climate change |
| Great ShakeOut of Puerto Rico: Participation of Agencies, Municipalities, Organizations and the general public in an earthquake drill "Great ShakeOut of Puerto Rico." The purpose of this exercise is to corroborate the interagency communication and mobilization of various immediate response agencies, as well as to check the Emergency Alert System (EAS). | ▪ RSPR<br>▪ FEMA<br>▪ AEMEAD<br>▪ SECC<br>▪ EAS-PR<br>▪ NOAA<br>▪ Puerto Rico Radio Broadcasters Association | ▪ Earthquakes |
| CaribeWave: Participation of Agencies, Municipalities, Organizations and the general public in an annual TSUNAMI drill conducted in Puerto Rico. The purpose of this exercise is to corroborate the interagency communication and mobilization of various immediate response agencies, as well as to check the Emergency Alert System (EAS). | ▪ RSPR<br>▪ FEMA<br>▪ AEMEAD<br>▪ SECC<br>▪ EAS-PR<br>▪ NOAA<br>▪ Puerto Rico Radio Broadcasters Association | ▪ Tsunamis |
| Drafting of the Emergency Operational Plan for Patillas dam. The purpose of this Plan is to coordinate all actions assigned to the organizations to prevent or reduce the direct and indirect effects of a failure, malfunction, breakage or collapse of the Patillas dam either by a natural or human-caused event. | ▪ AEMEAD<br>▪ OMME-Patillas<br>▪ AEE | ▪ Flood<br>▪ Other related to the failure or breakage of the Dam |
| Review and approval of Land Subdivision Regulation-Planning Regulation No. 34, which establishes guidelines, controls and coordination between the developer and entities responsible of the infrastructure necessary for | ▪ JP<br>▪ OGPe | ▪ All hazards |

| *Projects* | *Agencies or entities* | *Hazard to mitigate* |
|---|---|---|
| the proposed use, since early stages of the process. | | |
| Construction of a scientific research tower at the Guánica Dry Forest, which will function as the only monitoring center for research of climate change at the dry forests of the Caribbean basin and United States. The construction of this research tower, in charge of the National Ecological Observatory Network (NEON), is part of an agreement between the DRNA, NEON and the National Science Foundation (NSF), which will allow that scientists of all the world can analyze data on real time collected during the next 30 years and will help to analyze the climate change impact on the dry forests, soil characteristics, water, climate, environment and organisms that live in the forest. | ▪ DRNA<br>▪ NEON<br>▪ NSF | ▪ Climate change |
| Start of the Official Reference System for Maritime Terrestrial Zone Delineations, as required by Executive Order OE-2013-019. The delineation of the ZMT proposes an island-wide delimiting line between public domain and particular interests, that serves a reference for owners of coastal lands, land surveyors professionals, and for the Government execute ministerial evaluations in an effective, fast and transparent manner, and foster construction developments apt for coastal zones. | ▪ DRNA<br>▪ PMZC | ▪ Floods<br>▪ Tsunamis<br>▪ Coastal Erosion |
| Acquisition, demolition and mitigation of homes located in high risk areas of landslides in Bayamón -Villa España. | ▪ AEMEAD<br>▪ Municipality of Bayamón | ▪ Landslides |
| First phase of the Structural Rehabilitation of Loading Dock at Culebra, with HMGP funding allocation: $ 2,169,075 | ▪ AP | ▪ Climate change<br>▪ Flood |
| Puerto Rico Climate Projects (Statistically Downscaled by K. Hayhoe): Development and dissemination of a high-resolution national climate change dataset | ▪ CLCC, through NCSU, USGS CSC, USFWS | ▪ Climate change |

| *Projects* | *Agencies or entities* | *Hazard to mitigate* |
|---|---|---|
| The effects of changing land cover on streamflow simulation in Puerto Rico | ▪ CLCC, through NCSU, USGS CSC, USFWS, USFS | ▪ Flood |
| Future water resources in a tropical island with sparse data and steep precipitation gradients: predicting hydrology in Puerto Rico with statistically downscaled climate data | ▪ CLCC, through NCSU, USGS CSC, USFWS, USFS | ▪ Climate change<br>▪ Drought |
| New dynamically downscaled climate projections on the way. Developing multi-model ensemble projections of ecologically relevant climate variables for Puerto Rico and the US Caribbean | ▪ CLCC, through NCSU, USGS, CSC | ▪ Climate change |
| Vegetation dynamics related to climate and land use in Puerto Rico and the US Virgin Islands<br>*Ongoing* | ▪ CLCC, through USGS CSC, NCSU, IITF | ▪ Climate change |
| Study of coastal sediment dynamics in Loíza, Isla Verde, Ocean Park, Condado and Ensenada Boca Vieja<br>*Ongoing* | ▪ USACE<br>▪ UPRM<br>▪ DRNA-PMZC | ▪ Coastal Erosion<br>▪ Flood |
| Study of sediment dynamics in the coasts of Rincón<br>*Ongoing* | ▪ USACE<br>▪ UPRM<br>▪ DRNA-PMZC | ▪ Coastal Erosion<br>▪ Flood |
| Evaluation of changes on the beaches of Puerto Rico, Culebra and Vieques<br>*Ongoing* | ▪ USACE<br>▪ UPRM<br>▪ DRNA-PMZC | ▪ Coastal Erosion<br>▪ Flood |
| Assessment of road design guidelines and storm drainage systems<br>*Ongoing* | ▪ DRNA-PMZC | ▪ Coastal Erosion<br>▪ Flood |
| Presentation: Erosion Control Strategies and Coastal Flooding Inspired by Nature-2015 | ▪ DRNA-PMZC | ▪ Coastal Erosion<br>▪ Flood |

Even though all the information regarding the benefits related to the development of these initiatives has not been obtained, it is important to acknowledge the following mitigation benefits:

- Increase the knowledge of the government, academia and general public regarding hazards and mitigation options.
- Strengthen state and local capacity to assess the development processes that may affect the vulnerability of the territory.
- Universities and organizations will continue to conduct studies and document scientific findings on hazards, environment and mitigation, which will be used to define public policy, inform the general public, identify necessary projects and apply for funding to conduct projects or more detailed analyses, among others.
- State and local government will continue to prepare or update territorial ordinance and mitigation plans, and response to hazards, which will allow to address social, physical and economic changes that occur over time.
- Simulation exercises carried out, as the Great ShakeOut of Puerto Rico and CaribeWave, will help raise awareness about the dangers of earthquakes and tsunamis, and to identify areas where it is necessary to make corrections.

## 3.3 Prioritization of Mitigation Actions

In order to establish the priorities of the mitigation actions proposed in the 2016 PEMPN, "categories of action" were created, taking into consideration the feasibility of implementation

and the needs identified as a result of the evaluation of the actions of the 2011 PEMPN. The categories of action established in order of importance, are:

1. Education, information exchange and strengthening the relationship between Agencies, Municipalities, Organizations and the general public

2. Usage of instruments, tools and exercises for the analysis and hazard mitigation

3. Update or preparation of risk and vulnerability analysis and identification of mitigation actions

4. Management and development of activities, plans and mitigation projects

It is important to acknowledge that the government agencies have the right to set their priorities taking into account their multiple responsibilities, and the limited financial and human resources, among others aspects. The set of priorities presented below are for the development and implementation of mitigation activities according to action categories. Also, it is defined the responsible and supporting agencies /organizations, funding sources and the timeframe in which the actions should be developed and implemented. In order to have an effective implementation strategy of the 2016 PEMPN, GAR and AEMEAD should perform the following activities:

- Define roles and responsibilities for agencies, municipalities and participating organizations.

- Confirm the commitment of the Agencies, Municipalities and organizations to implement the mitigation actions through communications or agreements.

- Prepare a list of materials, information, technical and budgetary resources available and/or necessary for the implementation of actions.

- Coordinate meetings or workshops to start on the development and implementation of mitigation actions.

- Review and refine the proposed timeframe for the implementation of mitigation actions to include more specific dates.

# 2016 PEMPN MITIGATION ACTIONS PRIORITIES

| *Mitigation actions and action categories* | *Responsible and Supporting agencies* | *Funding sources* | *Timeframe and implementation* |
|---|---|---|---|
| *Action category:* *Education, information exchange and strengthening the relationship between Agencies, Municipalities, Organizations and the general public* | | | |
| **PRIORITY 1**<br>*Action 1.1.1*<br>Collect and distribute to State Government agencies, up-to-date information regarding hazards that affect Puerto Rico, vulnerability, and alternatives on how to mitigate them in order to increase the knowledge of its staff.. | ▪ GAR<br>▪ AEMEAD<br>▪ JP<br>▪ DRNA<br>▪ Other agencies and organizations that collect information and perform analysis | According to the available budget of the agencies | Ongoing |
| **PRIORITY 2**<br>*Action 1.2.8*<br>Provide the municipalities with continued access to updated information on the hazards affecting Puerto Rico, mitigation measures and analysis tools available through the Internet and/or database, in order to increase knowledge of its staff and to provide tools that can be used to analyze the vulnerability of its territory. | ▪ GAR<br>▪ AEMEAD<br>▪ JP | According to the available budget of the agencies | Ongoing |
| **PRIORITY 3**<br>*Action 1.3.12*<br>Increase the efforts and mechanisms to inform non-governmental organizations and citizens on natural and unnatural hazards, mitigation alternatives and response guides to dangers, through: agencies and municipal websites, social networks, workshops or educational campaigns and the development of partnerships with the media to disseminate information, among others that can be identified. | ▪ GAR<br>▪ AEMEAD<br>▪ JP<br>▪ DRNA<br>▪ Other agencies and organizations that collect information and perform analysis | According to the available budget of the agencies | Ongoing |
| **PRIORITY 4**<br>*Action 1.3.14*<br>Provide information on hazard mitigation measures related to the construction process to professional organizations such as planners, architects, surveyors and engineers, among others, in order to increase their knowledge in the | ▪ GAR<br>▪ AEMEAD<br>▪ JP<br>▪ DRNA<br>▪ Other agencies and organizations that collect | According to the available budget of the agencies | Ongoing |

| | | | |
|---|---|---|---|
| area, including promoting mitigation measures from the initial stages of development of plans and public and private projects, and emphasize the importance of adhering to building codes applicable in Puerto Rico. | information and perform analysis | | |
| **PRIORITY 5**<br>*Action 1.1.2*<br>Foster and encourage the State Government agencies to publish on their websites the official information received regarding hazards affecting Puerto Rico, vulnerability and alternatives on how to mitigate them. | ▪ GAR<br>▪ AEMEAD<br>▪ All State Agencies | According to the available budget of the agencies | Ongoing |
| **PRIORITY 6**<br>*Action 3.1.19*<br>Establish a system for collecting historical data of past events that are needed when preparing the BCA of mitigation projects included in the municipal plans. Share relevant information on vulnerability and hazard analysis in Puerto Rico that different sectors work directly or indirectly related to the hazard mitigation processes in order to disseminate the information and systematically promote the need for and benefits of mitigating such hazards. | ▪ GAR<br>▪ AEMEAD<br>▪ JP | According to the available budget of the agencies | Ongoing |
| **PRIORITY 7**<br>*Action 1.1.3*<br>Advise State Government agencies to incorporate hazard mitigation principles into their routine operations . | ▪ GAR<br>▪ AEMEAD | According to the available budget | Ongoing, annual campaign |
| **PRIORITY 8**<br>*Action 1.2.11*<br>Advise the municipalities to integrate the hazard mitigation measures stated in their Municipal Mitigation Plans into other plans, such as the Land-Use Plans . | ▪ GAR<br>▪ AEMEAD | According to the available budget | Ongoing, annual campaign |
| **PRIORITY 9**<br>*Action 1.3.13*<br>Prepare and distribute simple design plans of construction models for single family homes that incorporate protection measures against strong winds, landslides and earthquakes, and promote the importance of including these measures in housing construction. | ▪ AEMEAD<br>▪ JP | According to the available budget and competitive PDM | 1 to 2 years after the approval of the PEMPN |

| | | | |
|---|---|---|---|
| **PRIORITY 10**<br>*Action 3.1.20*<br>Promote the Hazard Mitigation and Adaptation to Climate Change Guidelines as stated in the Puerto Rico Land-Use Plans (PUT), complying with the provision of the PUT that states that all planning tools, effective November 19, 2015, should include mitigation and adaptation to climate change. | ▪ AEMEAD<br>▪ JP | According to the available budget | Ongoing |
| **PRIORITY 11**<br>*Action 3.1.21*<br>Coordinate efforts with educational institutions to incorporate topics of natural and technological hazards mitigation in the architecture, engineering and planning curriculum. | ▪ GAR<br>▪ AEMEAD<br>▪ Higher learning institutions such as: UPR, UMET, UPPR, PUCPR | According to the available budget | 2 to 3 years after the approval of the PEMPN |
| **PRIORITY 12**<br>*Action 3.1.22*<br>Establish agreements with educational institutions to gather information related to research on analysis of natural and unnatural hazards, mitigation strategies and analysis tools. | ▪ GAR<br>▪ AEMEAD<br>▪ Higher learning institutions such as: UPS, UMET, UPPR, PUCPR | According to the available budget | 2 to 3 years after the approval of the PEMPN |
| **PRIORITY 13**<br>*Action 3.1.23*<br>Maintain communication and coordination with the Office of the Coastal Zone Management Program, the Water Resources and Climate Change Program ascribed to the Department of Natural and Environmental Resources, the National Weather Service, the Aqueduct and Sewer Authority, and other relevant agencies to increase safety and guidance to coastal communities to integrate actions that are identified and can be developed to mitigate the effects of climate change. Similarly, work with the communities experiencing the effects of droughts, fires or other risks caused by the projected climate change. | ▪ GAR<br>▪ AEMEAD<br>▪ DRNA | According to the available budget | Ongoing |

| *Action category:* *Usage of instruments, tools and exercises for the analysis and hazard mitigation* | | | |
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| **PRIORITY 14**<br>*Action 3.2.25*<br>Promote the use and transfer of tools and analysis technologies available, such as GIS and HAZUS, to identify vulnerable areas or sectors, estimate the physical, social and economic impacts that the hazards may cause, and define mitigation actions. | ▪ GAR<br>▪ AEMEAD<br>▪ JP | According to the available budget | Ongoing |
| **PRIORITY 15**<br>*Action 3.2.24*<br>Work with the municipalities and agencies related to the process of planning, evaluation and approval of projects, so they integrate hazard analysis as a requirement for project evaluation or public and private developments and therefore avoid the effect of the vulnerability of certain hazards. In addition, use the regional planning instruments as stated in the Land-Use Plan of the Puerto Rico Planning Board and Territorial Ordinance Plans of the Autonomous Municipalities as hazard mitigation mechanisms. | ▪ GAR<br>▪ AEMEAD<br>▪ JP<br>▪ OGPe<br>▪ Municipalities | According to the available budget | Ongoing |
| **PRIORITY 16**<br>*Action 3.2.27*<br>Promote the participation of the coordinators of the State Interagency Mitigation Committee in the available processes, such as: public hearings and be an active member of committees and working groups to analyze, comment and ensure that mitigation action are taken into consideration or integrated in the projects, plans or other initiatives proposed and that may affect the vulnerability to hazards. | ▪ AEMEAD | According to the available budget | Ongoing |
| **PRIORITY 17**<br>*Action 3.2.26*<br>Strengthen the system sensors and early warning risk systems at the State and Municipal level, as a preparedness measure and mitigate the potential impact of a hazardous event to reduce or eliminate loss of life. | ▪ GAR<br>▪ AEMEAD<br>▪ Municipalities<br>▪ NOAA<br>▪ UPRM<br>▪ RSPR | According to the available budget | Ongoing |
| **PRIORITY 18**<br>*Action 3.2.28*<br>Promote the acquisition of flood insurance in all flood-prone communities throughout the island, of the National Program Flood Insurance | ▪ AEMEAD<br>▪ JP<br>▪ Municipalities | According to the available budget | Ongoing |

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| coordinated by the Floodplain Management under the Planning Board, as well as to promote practices to mitigate floods in these communities in order to reduce losses and associated costs to this hazard. | | | |
| **PRIORITY 19**<br>*Action 3.2.29*<br>Promote the participation of the agencies, municipalities, organizations and citizens in the planning process, drills and preparation exercises for the possible impact of earthquakes, floods and tsunamis, among others, to identify deficiencies that when corrected before the possible hazard incident occurs will become mitigation strategies; practice the recommended steps to follow during the incident and ascertain the citizenship and agencies readiness related to mitigation and management of hazards and emergencies. | ▪ GAR<br>▪ AEMEAD<br>▪ RSPR<br>▪ NOAA<br>▪ FEMA | According to the available budget | Ongoing, at least annually |
| **PRIORITY 20**<br>*Action 3.2.30*<br>Promote the participation of communities, practitioners, academics and religious groups, among others, in the Community Emergency Response Teams (CERT) to acquire basic knowledge on how to respond in an emergency, identify structural and nonstructural hazards, and prepare mitigation and action plans. | ▪ AEMEAD<br>▪ OMME | According to the available budget | Ongoing |
| *Action category:*<br>*Update or preparation of risk and vulnerability analysis and identification of mitigation actions* | | | |
| **PRIORITY 21**<br>*Action 1.1.4*<br>Require from each State Agency participating in the Interagency Mitigation Committee to complete or update their risk analysis, identification of hazards and potential projects to mitigate risk vulnerability in order to reduce the vulnerability of the structures of the agencies. | ▪ GAR<br>▪ AEMEAD<br>▪ Agencies participating in the Interagency Mitigation Committee | According to the available budget | Ongoing |
| **PRIORITY 22**<br>*Action 1.1.5*<br>Identify, evaluate and assess the hazard vulnerability of state critical facilities, emphasizing on the dangers of floods, hurricanes, landslides and earthquakes, in order to identify mitigation alternatives (e.g. Improvements or relocation of structures) to reduce or eliminate vulnerabilities. Particularly it is necessary to: | ▪ GAR<br>▪ AEMEAD<br>▪ State agencies | According to the available budget | Ongoing |

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| ➢ Promote the importance of maintaining updated vulnerability analysis of structures and facilities of state agencies that regularly are not associated with the hazard mitigation process. An example could be the Department of Agriculture, whose industry is regularly struck by floods, droughts and hurricanes; and the Puerto Rico Tourism Company, whose facilities and attractions located in coastal or forested areas are exposed to the impact of various hazards. Distribute the analysis results with agencies related to the planning and mitigation processes, and identify measures to mitigate the vulnerability of these sectors.<br><br>➢ Promote the importance of maintaining updated vulnerability analysis of the critical infrastructure of Puerto Rico, such as: Electric Power Authority, Aqueduct and Sewer Authority, Department of Transportation and Public Works, and Telecommunications Regulatory Board. Distribute the analysis results with agencies related to planning and mitigation processes and identify measures to mitigate the vulnerability of the critical infrastructure. | | | |
| *Action category:*<br>*Management and development of activities, plans and mitigation projects* | | | |
| **PRIORITY 23**<br>*Action 1.1.6*<br>Identify specific restoration or relocation projects of state critical facilities that can be developed prior to the occurrence of the disaster with funding sources such as Federal Highway and FEMA-PDM matched with local funds, or those that can be activated after a disaster with funds from FEMA HMGP. | ▪ GAR<br>▪ AEMEAD<br>▪ FEMA | ▪ PDM<br>▪ HMGP<br>▪ FMA<br>▪ Matched with state and local funds | Ongoing |
| **PRIORITY 24**<br>*Action 1.2.9*<br>Provide technical assistance to municipalities during the proposal preparation process to obtain funding for the development, revision and implementation of natural and unnatural hazard mitigation plans and projects. | ▪ GAR<br>▪ AEMEAD<br>▪ FEMA | According to the available budget | Ongoing |

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| **PRIORITY 25**<br>*Action 1.2.10*<br>Offer training to municipalities on the preparation, adoption and implementation of the Municipal Mitigation Plans and on the development of mitigation activities and projects. | ▪ GAR<br>▪ AEMEAD<br>▪ FEMA | According to the available budget | Ongoing |
| **PRIORITY 26**<br>*Action 2.1.16*<br>Identify and assess the availability of federal, state and private funds to plan and develop hazard mitigation projects throughout Puerto Rico . | ▪ GAR<br>▪ AEMEAD<br>▪ FEMA | ▪ PDM<br>▪ HMGP<br>▪ FMA<br>▪ Matched with state and local funds | Ongoing |
| **PRIORITY 27**<br>*Action 2.1.15*<br>Continue with the function of safeguarding the compliance with the funds allocated for the development and implementation of mitigation measures and projects . | ▪ GAR<br>▪ AEMEAD | According to the available budget | Ongoing |
| **PRIORITY 28**<br>*Action 2.1.17*<br>Maintain a communication process with the agencies, municipalities and organizations to obtain information about the implementation status of the plans and mitigation projects and integrate them into future revisions of the PEMPN. | ▪ GAR<br>▪ AEMEAD | According to the available budget | Ongoing |
| **PRIORITY 29**<br>*Action 1.1.7*<br>Increase the number of qualified personnel, such as architects, engineers and planners within state agencies to assess and manage programs and projects that impact the process of hazard mitigation. | ▪ Agencies involved in project evaluation and approval. Such as: JP, OGPe and DRNA. | According to the available budget | Ongoing |
| **PRIORITY 30**<br>*Action 2.1.18*<br>Coordinate and carry out training activities through the Office of the GAR and AEMEAD, on how to effectively use the FEMA-BCA (Benefit Cost Analysis) computer program for the cost-benefit analysis of mitigation projects. These training activities may be offered to municipalities and state agencies staff responsible of preparing federal proposals, for them to become more specialized in the process of BCA. | ▪ GAR<br>▪ AEMEAD | ▪ PDM<br>▪ HMGP<br>▪ FMA<br>▪ Matched with state funds | Ongoing |

# CHAPTER 4: STATE MITIGATION CAPABILITIES

The State mitigation capacity is described as the resources and tools to reduce or eliminate the vulnerability to identified hazards. The development and strengthening of the institutions and mechanisms of the State are fundamental to increase resilience to threats. The capability to mitigate hazards depends on physical, economic, social, regulatory, and politic factors discussed in this chapter. This section provides information about the States resources or tools to mitigate natural hazards and to support the implementation of the goals, objectives and mitigation actions proposed in the 2016 PEMPN.

## 4.1 Administrative and Operational Capability to Implement the PEMPN

The public policy of the Government of Puerto Rico concerning those emergency situations that could affect the Island, established as the Act No. 211 of August 2, 1999, as amended, known as the "Commonwealth of Puerto Rico Emergency Management and Disaster Administration Agency Act", is *to protect our inhabitants in those emergency situations or disasters that affect the Commonwealth of Puerto Rico and to provide them with the necessary assistance in the speediest and most effective manner possible to ensure the protection of their lives and property before, during and after the event.* Likewise, it is the obligation of the Government to achieve the earliest recovery and stabilization of the services essential to our citizens and to our industrial, commercial and governmental activities. Act No. 211 created the Commonwealth of Puerto Rico Emergency Management and Disaster Administration Agency (AEMEAD), with the power to implement the public policy and coordinate all pertinent Commonwealth, municipal, private and federal plans.

AEMEAD is responsible of Puerto Rico emergency management based on the following phases: preparation (before), mitigation (before and after), response (during), and recovery (after); and to provide services to citizens due to natural and technological events or those created by man. To carry out its functions within the laws, rules and regulations applicable to Puerto Rico, the AEMEAD coordinates its duties with the Office of the Governor's Authorized Representative (GAR) and FEMA.

AEMEAD offers its services at an all island level with 12 Regional Offices. The 12 Regional Offices denominated as Zones include the 78 municipalities of Puerto Rico and provide quick response and a more close attention to the communities. The 12 Zones are: Zone I: San Juan, Zone II: Vega Baja, Zone III: Arecibo, Zone IV: Aguadilla, Zone V: Mayagüez, Zone VI: Ponce, Zone VII: Utuado, Zone VIII: Comerío, Zone IX: Guayama, Zone X: Caguas, Zone XI: Humacao and Zone XII: Ceiba. Every Municipality also has a Municipal Emergency Management Office (OMME). The AEMEAD Regional Offices must provide technical and financial support to the OMME, through State and federal funding administered by AEMEAD.

AEMEAD has an Administrative Area and four (4) main operational divisions: Preparation Division, Recovery Division, Response Division and Mitigation Division. To carry out their responsabilities, the Agency has employees in the areas of preparation, response, mitigation and recovery that receive periodic training in each of their areas of specialty. As discussed in Chapter 1, the Agency also has two (2) Interagency Committees: Commonwealth Committee for State Emergency Management, and Interagency Natural and Technological Risk Management Committee that have the function of complementing and reviewing the AEMEAD operations.

In terms of pre-disaster and post-disaster management plans, AEMEAD has a State Response Plan. Each agency that integrates the Interagency Committee for State Emergency Management has a Recovery Plan that is coordinated and integrated to the State Response Plan. These plans are intended to safeguard life, property, and ensure the continuity of services. AEMEAD also has a Commonwealth Mitigation Plan (PEMPN, 2011) which is being updated with the present document: the 2016 PEMPN. Each agency that composes the Interagency Natural and Technological Risk Management Committee performs natural hazards mitigation activities coordinated by the AEMEAD Mitigation Division. Agencies are required to complete a regular process of updating their mitigation plans. On the other hand, each Municipal Emergency Management Office has its Emergency Operation Plan; which is coordinated with the State Response Plan. At the same time, municipalities develop Local Mitigation Plans that are updated every five (5) years. In addition, the OMMEs are responsible of conducting pre-disaster and post-disaster mitigation activities in their respective territories.

AEMEAD, in conjunction with the GAR, is responsible for ensuring the development and implementation of the 2016 PEMPN. For this, as well as administrative, legal and economic internal resources, it counts with resources and tools that exist in the State to support the mitigation of identified hazards and reduce or eliminate the vulnerability to which we are exposed. The laws, regulations and programs most relevant and related to hazards mitigation are discussed below.

## 4.2 Legal and Regulatory Capability for Hazard Mitigation

Section 19 of Article II of the Constitution of the Commonwealth of Puerto Rico recognizes ample power of the Legislature to approve laws for the protection of the life, health, and the

welfare of the citizenry. This is so, in harmony with the representative nature of the people that the legislative bodies hold, and as a part of the inherent authority of the state. This authority delegated to the Legislature, through the Constitution, has generated various environmental laws aimed to establish the public policy of the Commonwealth of Puerto Rico (ELA) to protect people in situations of emergency or natural disasters and to minimize or avoid the risk of natural disaster.

Puerto Rico has a variety of laws and regulations that affect hazards management, land use and development projects. There are agencies, offices or state, federal and municipal departments that have jurisdiction over the hazards management, development, planning and land use planning. Planning mechanisms that exist in Puerto Rico provide the opportunity to implement hazard mitigation actions in early stages of development and thus reduce the potential for future damages caused by disasters. In some cases, the land use regulations and its development reflect a broad understanding of natural hazards, such as: landslides and floods. According to experts, Puerto Rico has some policies and regulations better defined for the land use in the Region of the Caribbean (PEMPN, 2011). As described below, the discussion about laws, regulations, policies and programs, in addition to those directly related to hazards mitigation, focus on the process of development and land use in Puerto Rico as elements that offer the opportunity to mitigate the impacts of hazards in early stages; vital aspect to reduce vulnerability to risks in Puerto Rico.

### 4.2.1 Planning Board

The Planning Board, as granted in Act No. 75 of 1975, has the general purpose of guiding the integral development of Puerto Rico in a coordinated, adequate, economic manner, according to the present and future social needs and human, environmental, physical and

economic resources. To accomplish this purpose, laws, plans and regulations have been enacted, and the most relevant to the regional planning and hazards mitigation are mentioned below.

- ***Land-Use Plan***

  The Land-Use Plan (PUT), effective November 19, 2015, is an ordinance instrument which aims to establish a territorial model that serves as an urban, environmental and infrastructure development reference at the time of proposing and conducting projects, plans and programs. Some functions of the PUT, as described at the introduction of the document, are:

  ✓ Give value to Puerto Rico, identifying the land according to its heritage, ecological, agricultural, landscape and rural or urban worth.

  ✓ Improve the coordination of the planning and development efforts carried out by State agencies, public corporations and municipalities.

  ✓ Conserve and promote at least 600,000 "cuerdas" of agricultural value.

  ✓ Provide alternatives to accommodate the housing needs and new developments, without negatively impacting and compromising agricultural soils, natural systems, hydrographic basins, aquifers, heritage values and landscapes.

  ✓ Promote that citizens dwell in safe areas and that the primary infrastructures needed are out of risk areas.

  ✓ Take steps to adapt and mitigate climate change.

The purpose and main functions of the PUT, as observed, are consistent with the goals, objectives and mitigation actions set out in the 2016 PEMPN. The PUT incorporates the theme of climate change as one of the important matters to be considered. In addition, some of the goals and objectives presented in the PUT reflect commitment to mitigating risks and reducing losses of life and property. These include:

✓ Goal 1: Focus development and redevelopment in communities where infrastructure already exists and development is planned.

*Objectives:*

- *Connection with nature:* Provide access within a community to natural systems and recreational areas through pedestrian access, cycling or using public transport, thus, eliminating exclusive dependence on the automobile.
- *Develop resilience to risks:* Plan and construct coastal communities and urban environments in the interior of the island, so that human habitat and infrastructure are protected from the risks associated with the hazards and climate change: increase in the sea level, storm surges, hurricanes, heavy rain, extreme temperatures and the effects of the heat in the island's urban soils.

✓ Goal 2: Preserve and protect natural, archaeological, or agricultural resources, rural soils and those environmentally-sensitive to the adverse effects of uncontrolled construction.

*Objectives:*

- *Protect the environment, natural resources and biodiversity*: Protect environmentally sensitive areas through the mechanisms of conservation easements, transfers of development rights, the acquisition of ~~the~~ property, the classification and rating, among others. Protect wetlands, lakes, rivers and other bodies of water from the impact of run-offs from higher ground.

- *Promote adaptable and resilient ecosystems:* Identify and locate on maps, and protect the lands and waters that provide services and important functions to the ecosystem from the impacts of climate change, development, impermeable coating, and invasive species and other pests and diseases.

- *Tackle climate change:* Reduce energy consumption and greenhouse gas emissions, particularly with regard to energy generation and conservation, natural resource management, land use and transport.

Also, PUT recommends to carry out sectoral plans, as defined in the Memorial of the PUT, these plans are planning exercises prepared by Central Government agencies with competence in a specific topic. Its intention is to establish a detailed public policy which has implications for the island-wide territorial ordinance, in a supraregional or functional area and to include an action program at a defined time. Sectoral plans will have preeminence over the Territorial Ordinance Plans of the municipalities.

The sectoral plans recommended by PUT, are:

✓ Reservoirs and basins

✓ Airports

- ✓ Ports
- ✓ Coasts
- ✓ Solid wastes
- ✓ Quarries
- ✓ Tourism
- ✓ Agriculture
- ✓ Citizen accessibility and mobility
- ✓ Landscape and archaeological resources

In particular, the Sectoral Coastal Plan aims to address the management of the coasts of Puerto Rico, with special emphasis on the consideration of risk, resilience and adaptation to climate change, the eviction or re-accommodation of communities, illegal construction and access to the beaches along the offshore coast.

- ***Joint Regulation for the Evaluation and Issue of Permits Regarding Land Development and Use***

This Regulation, effective March 24, 2015, has the purpose of detailing the integrated permits system related to the development and land use, according to the public policy outlined in the Act No. 161 of December 1, 2009, as amended, known as the Puerto Rico Permit Process Reform Act, by creating clearer, uniform and objective rules to speed up a more efficient process, consolidating all applicable rules. The Joint Regulation repeals regulations and resolutions of the Planning Board, including the Planning Regulation No. 4: *Puerto Rico Zoning Regulation*.

The Joint Regulation has procedures for the granting of permits, recommendations, consultations and/or certifications for any project or development. Some sections of the Regulation that discuss and present regulations directly related to emergency management and hazards mitigation, are:

- ✓ Chapter 12: Processing of Permits, Recommendations, Consultations and/or Certifications during States of Emergency, according to provisions of Act No. 76 of May 5, 2000.
- ✓ Chapter 13: Environmental Assessment where proceedings are defined so the instrumentalities of the Commonwealth, before performing an action or final determination, take into account environmental considerations of such action or determination.

It also includes processes for areas of special planning, and nature reserves, which are intended to control urban growth in these areas and preserve natural resources, including:

- ✓ Chapter 29: Special Zoning for the Puerto Rico Reserves and Agricultural Corridors.
- ✓ Chapter 30: Zoning for the Coastal Zone and the Access to Beaches and Coasts of Puerto Rico
- ✓ Chapter 31: Special Zoning of La Parguera at the Municipality of Lajas
- ✓ Chapter 32: Special Zoning of the San Cristobal Canyon at Aibonito and Barranquitas
- ✓ Chapter 33: Special Zoning of the Hydrographic Basin of the Tortuguero Lagoon

✓ Chapter 34: Special Zoning for the Non-Urban Zones of the Municipalities Surrounding the Caribbean National Park (El Yunque)

Another important section of the Joint Regulation is Volume VII: Infrastructure, where the requirements are established for the application of recommendations and permits on the electricity infrastructure, aqueducts and sewers, and roads, among others. As part of the requirements of the infrastructure assessment, it is establish that plans must include information about bodies of water, public roads, planting areas, zoning, areas susceptible to flooding, topographic plans, among others. In addition, the OGPe may request more specific studies (eg. Study of soil) for the analysis of infrastructure projects that may impact existing risk vulnerability.

The implementation of the Joint Regulation is fundamental for hazard mitigation because the correct analysis of projects can help to reduce risk vulnerability. Conversely, no or poor project evaluation can increase risk vulnerability.

- ***Land Subdivision Regulation***

The Land Subdivision Regulation, adopted January 27, 2016, establishes guidelines, controls and coordination between the developer and the entities responsible for the infrastructure necessary for the proposed use, from the earliest stages of the processing of permits. Therefore, it becomes another instrument for project evaluation, in which correct implementation is essential for hazards mitigation.

- ***Special Flood Hazard Areas Regulation***

The Special Flood Hazard Areas Regulation (Regulation No. 13), as revised, establishes the safety measures for the control of buildings and land developments in areas declared as a flood risk. This Regulation has, among others, the following purposes:

✓ To protect life and human health.

✓ To reduce the need to use public funds for flood control works and mitigation plans.

✓ To reduce the need for rescue and aid efforts associated with floods.

✓ To prevent changes to the natural hydrology of the flood-prone valleys to protect and conserve wetlands.

The Planning Board, in addition to administering the Special Flood Hazard Areas Regulation, is the Coordinating Agency of the *National Flood Insurance Program* and adopts the Flood Insurance Rate Maps (FIRM) prepared and approved by FEMA. The processes and definitions associated with the National Flood Insurance Program are part of Regulation No. 13. The implementation of Regulation No. 13 is crucial as it directly addresses the danger of flooding, which translates into a main tool for this hazard mitigation.

- ***Act 76, year 2000***

Exempts the agencies, public corporations and government instrumentalities involved in the processing of permits, endorsements, consultations and/or

certifications that may be related to projects that arise as a result of states of emergency declared by Executive Orders of the Governor of Puerto Rico or the President of the United States, from compliance with the terms and procedures established in the organic laws of the Planning Board, Autonomous Municipalities and Uniform Administrative Procedures. In addition, establishes special provisions to handle the procedures before the JP, JCA; adopt the procedure to deal with emergency situations or events that require the execution of works, projects or programs that do not require the issuance of permits, endorsements, consultations and/or certifications; empower the Governor to enact, amend, revoke, regulations and orders, and rescind or resolve agreements, contracts or any part of them during the state of emergency; provide the term of effectiveness of the executive orders; enable the different government agencies for the accelerated processing of the procedures established in the abovementioned laws.

This law applies to government agencies involved in the projects submitted under the provisions of this Act, however the Planning Board is in charge of the administrative procedures established.

### 4.2.2 Environmental Quality Board

The Environmental Quality Board (JCA) has the main function of protecting and preserving the environment, using the resources necessary to prevent and eliminate damages that may affect it by keeping a balance between economic development and the environment, in accordance with Act No. 416 of September 2004, known as the

Environmental Public Policy Act. The JCA has enacted regulations with the primary purpose of establishing rules that minimize damages to the environment and to establish the controls for activities that cause pollution. In general terms, the JCA addresses the pollution in land, bodies of water and air, and checks the environmental impact statements of all significant development projects on an individual basis.

The aspects that the JCA attends regarding land, bodies of water and air pollution, are particularly important because it addresses and identifies actions to mitigate hazards that may be associated with human actions.

- ***Environmental Public Policy Act***

  The Environmental Public Policy Act (Act No. 416 of September 22, 2004), administered and monitored by the Environmental Quality Board, states that it is public policy *to use all practical means and measures, including technical and financial assistance, with the purpose of encouraging and promoting general wellness and ensuring that all natural systems are healthy and able to sustain life in all its forms, as well as social and economic activity.*

  This Act describes the considerations to be taken into account when evaluating a project and establishes the following four objectives for the development in Puerto Rico: (1) the most effective protection of the environment and natural resources; (2) the most prudent and efficient use for the benefit of all citizens; (3) social progress that acknowledges everybody's needs; and (4) reaching and maintaining high and stable economic growth and employment rates.

### 4.2.3 Department of Natural and Environmental Resources

The Department of Natural and Environmental Resources (DRNA) is a Department umbrella responsible for the implementation and formulation of environmental public policy and the protection and conservation of the natural, environmental and energy resources. Its mission is to protect, conserve and manage the environmental and natural resources of the country in a balanced way, to guarantee future generations enjoyment and encourage a better quality of life.

The Natural Resources Administration, through its components, is responsible for the development and implementation of programs for conservation and management of water resources, flood control and maintenance of bodies of water, woodland resources, forests, coastal and marine resources, fisheries, wildlife, nature reserves and wildlife refuges. In coordination with the Assistant Secretary for Integrated Planning, it is also responsible for the development and implementation of the processes of acquisition of high ecological value lands and necessary land for the development of flood control works.

Also, DRNA, through the Coastal Zone Division, is the leading agency for the implementation of the Coastal Zone Management Program (PMZC). This task is carried out in close coordination with the Planning Board, the government agency responsible for administering the Federal Compatibility Certification Process with the Program. Other entities such as the Environmental Quality Board, Permit Management Office, Department of Agriculture and Institute of Puerto Rican Culture, as well as coastal municipalities, have responsibility for management of the coast and their marine and coastal resources.

In addition, the Organic Act of the DRNA, Act No. 23 of 1972, conferred in the Secretary of the DRNA the duty to *"exercise the monitoring and conservation of territorial waters, land submerged under them and the maritime zone, grant franchises, permits and licenses of public character for their use and exploitation, and establish by regulation the rights to be paid by the same"*. Regulation No. 4860 of the DRNA, Regulation for the Use, Surveillance, Conservation and Administration of the Territorial Waters, the Areas Submerged Under These and the Maritime Terrestrial Zone, of December 29, 1992, was adopted in accordance with these rules. Through this regulation, requirements are established for the use of maritime public domain property, territorial waters, land submerged, and maritime terrestrial zone. In order to provide the best information available for demarcating the inland limit of the maritime terrestrial zone, the DRNA has embarked on the development of the official Maritime Terrestrial Zone Reference System (SRO-ZMT). This official reference system aims to meet the threats to coastal natural systems, as well as public security.

The regulation of the coastal zone is crucial due to the pressures received for the development of these lands and by the effects of coastal erosion which exposed the infrastructure and structures adjacent to these natural systems, to greater and more frequent episodes of flooding and possible material losses. Existing regulations allow the conservation of resources associated with the coastal zone, protect industries or services that are developed in them and mitigate or eliminate their vulnerability.

- ***Puerto Rico Land Acquisition and Conservation Fund Act***

The fund that creates the Puerto Rico Land Acquisition and Conservation Fund Act (Act No. 268 of September 2003), as established, would be administered by the Department of Natural and Environmental Resources. It is important to emphasize that this is a parallel mechanism to other governmental and non-governmental initiatives that exist in the country. Some of these initiatives are the *Natural Patrimony Program* of the Department of Natural and Environmental Resources, the *Conservation Trust* and the *Citizens of the Karst*. These initiatives execute the acquisition (purchase) of environmentally sensitive lands to be conserved and/or protected from excessive development.

- ***Ecological Corridor of San Juan-Act No. 206 of 2003***

Act to designate the *Ecological Corridor of San Juan*, for the purpose of reserving and consolidating a green area of approximately 1,000 "cuerdas" that are part of the only remaining green areas of San Juan, as well as the *Northeast Ecological Corridor* on the eastern coast of the island of about 3,200 acres, which includes forests, wetlands, beaches, coral communities, and a bioluminescent lagoon. This Act was amended in 2004 to include the Cupey Arboretum within the Ecological Corridor of San Juan. The implementation of this Act relies on the Department of Natural and Environmental Resources which has the responsibility to acquire all the lands that comprise these farms and to establish agreements with other governmental, community and private entities.

- ***Puerto Rico Climate Change Council***

Recognizing Climate Change as one of the problems that threaten biodiversity and management of natural resources due to increases in temperatures, changes in precipitation patterns, ocean acidification, and sea level rise, among others, the Puerto Rico Climate Change Council (CCCPR) was created on November 2010. The CCCPR main goal is to conduct vulnerability assessment of Puerto Rico and recommend response strategies to these changes. The CCCPR is formed by four working groups: 1) Geophysical and Chemical Scientific Knowledge; 2) Ecology and Biodiversity; 3) Society and Economy; and 4) Communicating Climate Change and Coastal Hazards. The DRNA, through the Coastal Zone Management Program, serves as Executive and Technical Secretary of the Puerto Rico Climate Change Council. The Council functions as a laboratory of ideas and discussion forum where researchers and experts discuss about the state of climate, coasts and oceans, natural processes, land uses, socioeconomic activities and resources there contained, focusing mainly on the region of the Caribbean and Puerto Rico.

Various state and federal agencies, as well as environmental and academic organizations, are part of the CCCPR, among them: AEMEAD, JP, DRNA, UPR, UMET, CariCOOS, NCSU and NOAA. The result of the analyses and studies carried out by the CCCPR is vital to mitigate the variety of threats associated with climate change.

### 4.2.4 Permit Management Office, Building Codes and Review Processes

On December 1, 2009, Act No. 161, known as the Puerto Rico Permit Process Reform Act, among other things, created a new Integrated Permitting System and repealed Act No. 76 of June 24, 1975, as amended, known as the "Organic Act of the Regulations and Permits Administration". The Integrated Permit System (SIP) is a structure composed by the Permit Management Office (OGPe), the Office of the Chief Permit Inspector (OIGPe) and the Review Board (JR). The Planning Board is also part of the SIP, through its Shared Services Center (CSC). In the Statement of Motives of Act No. 161, the following reasons are identified for creating it:

*"The most important point is that a new permit system—one that is transparent, streamlined, and efficient—will boost our economy by helping to create tens upon thousands of jobs in the construction industry as well as permanent jobs in other sectors, which we need so dearly. Moreover, a new permit system law would enable us to establish an adequate balance between economic development and environmental protection.*

***Yes, the new permit system law will help us protect the environment. The present system is constantly circumvented precisely because of its complexity, its costliness, and its unreasonableness****. (Emphasis supplied.)*

*The present permit system is the main culprit of the vast amount of unsystematic, haphazard construction works all over Puerto Rico which threaten the environment, the health and even life, inasmuch as these are often built on unsafe grounds."*

*"The permit process for the development of construction works in Puerto Rico is in critical state which poses a threat against various socioeconomic, cultural, and entrepreneurial fronts. The inexorable truth is that the procedures whereby evaluations are conducted in order to grant permits is one of the most problematic and deficient areas managed by the Government. Consequently, such procedures gravely affect our development in general. It is therefore indispensable for us to give priority attention to this adverse situation and to design new alternatives to address such situation."*

According to Act No. 161, the causes of the problem with the permit process in Puerto Rico are:

1. Excessive regulations and duplication in case evaluation transactions, both internally and at the inter-government level
2. Slow manual processing
3. Excessive and burdensome documentation load
4. Noncompliance with the established deadlines
5. Lack of effective oversight and supervision ("fiscalización")
6. Unreasonability of and mistrust in the process

The OGPe directs six specialized divisions to assess compliance of each permit application submitted. The six (6) specialized divisions, are: 1) Environment; 2) Health and Safety; 3) Infrastructure; 4) Archaeology and Historic Conservation; 5) Recommendations on Use; and 6) Constructability and Energy and Building Codes.

The Environmental Compliance Evaluation Division, shall assess environmental assessment regarding all actions subject to environmental impact analysis under the Puerto Rico Environmental Public Policy Act. Furthermore, this Act creates the Green Permit, which shall be evaluated by the Environmental Compliance Evaluation Division by means of a Categorical Exclusion, to be granted to such projects or buildings that comply with green design guidelines.

The OGPe requires compliance with applicable building codes, which in the case of Puerto Rico is 2011 Puerto Rico Building Code (PRBC), effective March 1, 2011. The PRBC sets the parameters for the design and development of projects. The 2011 PRBC

addresses the design and installation of building systems through requirements emphasizing performance, and the wellness of public health and communities. This Code, together with the model codes of the International Code Council (ICC), enables for the development in accordance with the circumstances of Puerto Rico, which allows preventing and mitigating losses of life and construction during natural hazards events. The adoption of codes and laws that affect the process of construction in Puerto Rico, among other things, seeks to address deficiencies that had been identified in processes to enforce regulations and that were conducive to informal construction.

Federal laws related to hazard mitigation, are:

➢ **ROBERT T. STAFFORD DISASTER RELIEF AND EMERGENCY ASSISTANCE ACT**

This legislation includes two (2) sections directly related with mitigation activities. These are sections 409 and 404. Section 409 of the Act establishes as a requirement for federal assistance, that the territory that will receive the funds have to perform an analysis and assessment of natural hazards in areas where the funds will be used. Section 404 provides funds for cost-effective mitigation activities which reduce the potential risk of future disasters. These mitigation measures are identified in the natural hazards evaluation and recommendations under Section 409.

In addition, Section 322 (*Mitigation Planning*) of the above-mentioned Act enacted by Section 104 of the *Disaster Mitigation Act 2000; Public Law 106-390* the new approaches for hazard mitigation planning. Section 322 emphasizes in the need for State, local, or tribal government to coordinate among them the process of mitigation planning

and implementation of activities and related projects. Also, as a condition for receipt of financial assistance for disasters, it is required that states shall develop a mitigation plan, and create incentives to increase the coordination and integration of mitigation activities between the State and the municipalities. Section 322 ascertains as a new requirement the creation of local plans and authorize up to 7% of the HMGP funds available to be used in the development of State, local (municipal) and tribal government mitigation plans.

- **COASTAL BARRIER RESOURCES ACT (CBRA), PUBLIC LAW 97-348, APPROVED OCTOBER 18, 1982**

  It seeks to discourage any kind of development in areas identified as fragile or sensitive to wildlife, as well as prone to social disasters of natural causes, such as floods, through the prohibition of federal fund assignments or loans. According to the Act, those activities incurred by the federal government such as flood insurance administered by FEMA, the projects undertaken by the U.S. Army Corps of Engineers, as well as federal assistance for the construction of roads, sewerage systems, potable water systems, airports and bridges, are prohibited in these areas.

### 4.3 Hazard Analysis Capability

The State analysis tools also define the capability that it has to respond, analyze and mitigate identified hazards. To the extent that Puerto Rico has clear identification and analysis of risks may establish mitigation measures that ensure higher levels of safety and reduction of vulnerability. These are various tools and methodologies used for the identification and analysis of risks, but Puerto Rico recognizes three main tools that are managed and promoted by the

Planning Board: Geographic Data System, Environmental Assessment Interactive Portal and HAZUS. Although these three tools of analysis are those discussed below, all the resources involved in the management and analysis of information related to hazards, ranging from equipment, data, written reports and human resources define the State's ability to analyze and mitigate identified hazards.

### 4.3.1 Geographic Data System

Act No. 398 of September 9, 2000, created the Puerto Rico Geographic Data System, a central system of integrated digital geographic and mapping data which links different data banks and is the repository of all geographic data which is acquired, purchased or produced by any government body. The Planning Board administers the Geographic Data System Program as a geographic data information distribution center for the Government and general public. The main functions of the Geographic Data System are listed below:

- Optimize tools to make geographic information produced by Government Agencies fully accessible by Internet.
- Encourage the responsible, coordinated and standardized use of spatial data to make geographic information useful to multiple users.
- Update Puerto Rico spatial data in collaboration with different State, federal and municipal agencies.
- Facilitate and promote the use of standards and best practices in the collection, production, distribution and use of geographical data at the inter-agency level.
- Introduce GIS functionalities in the daily processes of governmental and private entities.

The Geographic Data System Program manages various projects to promote the analysis of different factors that have an impact on the environment, including:

- ***Environmental Evaluation Interactive Portal / "Puerto Rico Interactivo"***

  Geographical analysis tool that allows to locate and assess environmental and physical characteristics of a particular place and provides information on development policies associated with lands in Puerto Rico.

- ***HAZUS***

  Analysis model that seeks to identify those properties located in areas vulnerable to natural hazards. HAZUS combines mathematics, science and engineering with the Geographic Data System to estimate losses in lives and properties, and illustrate damages on a map. The project is worked in coordination with the Federal Emergency Management Agency.

## 4.4 State Financial Capacity to Implement Hazard Mitigation

Puerto Rico has State and federal funding for, among other things, manage the Government structure, offer services to the public and develop plans and projects, including those related to hazard mitigation. In recent years, the economy of Puerto Rico has faced great challenges and since the year 2005 retains a public policy of control and reduction of expenses of agencies and instrumentalities of the Government of Puerto Rico. The measures include: control over appointments and awards of contracts, the 5% reduction in costs of cell phones and other services, reduction of 85% of the fleet of motor vehicles, reduction of at least 10% of costs of

trust staff payroll and not to create career positions except when essential services offered by the Agency are at risk.

Taking into consideration the Island's economic situation is essential to analyze the financial capacity of the State. It is important to point out that even in the wake of the crisis, where there have been budget cuts in the agencies in order to meet the expenditure reduction public policy established, funds which are regularly assigned to mitigate hazards have not been directly impacted. The budget of Puerto Rico is discussed below in general terms, because it provides allocation of funds to each agency to comply with its functions. The federal resources related to hazard mitigation which Puerto Rico has access to are later discussed.

### 4.4.1 Budget of the Commonwealth of Puerto Rico

Information regarding the availability of state financial resources is collected from the budget of the Commonwealth of Puerto Rico which is prepared by the Office of Management and Budget, attached to the Office of the Governor. The state budget is a financial plan aimed at achieving specific goals within a set time, including an estimate of resources required and resources available to carry it out. The term budget is defined as: the comprehensive plan expressed in terms of financial goals and resources the Governor submits each year in order to meet the needs of the country and is sealed as the Budget of the Government of Puerto Rico. The budget document presents the Consolidated Annual Budget, which includes: the obligations and resources of the Government of Puerto Rico for all ordinary operating expenses and permanent improvements charged to General Fund, Federal Funds, Public Improvements, Special

State Funds, Loans and Bond Issues and the net budget of public corporations, including contributions and compensations granted by the Central Government.

The Government Budget that begins each July 1, is valid for one year, and draws from various sources, among which are:

- General Fund: In this Fund the overall activities of the government and those activities for which the government has not established a particular fund are registered and administered. It is the fund into which the moneys collected by the Department of Treasury enter. Afterwards, the Legislature makes appropriations to cover the various service programs and public investment for each fiscal year. These resources come from taxation, mainly on income, inheritance and donations, taxes on alcohol, cigarettes, petroleum products, motor vehicles and accessories, sales and use taxes, among others. These also include contributions that are levied on account of motor vehicle licenses and other licenses, rights, penalties and forfeitures, revenues from the lottery, customs duties, and excise taxes on shipments.

- Public Improvement Fund: Consists of proceeds from the sale of bonds authorized by the Legislature. These resources are used to finance the capital improvement program and cannot be used for operational costs of the agencies.

- Special State Funds: Funds authorized for specific purposes in accordance with current legislation. These originate from income tax collections, fees and licenses, service charges, contributions from individuals and grants from private organizations, and other collections typical of some government agencies.

- Federal Funds: Contributions made by the Government of the United States for education, health, social welfare, employment, and other permanent improvements. These resources do not require legislative action, since their use is determined by federal law.

- Budgetary Fund: It is capitalized annually by an amount not less than one percent of total net revenues of the last fiscal year. In addition, receives all income other than the General Fund net revenues not earmarked by law for a particular purpose. It is used to cover appropriations approved for any fiscal year when available revenue is not sufficient to cover them, and to honor the payment of the debt. It also provides the financial resources to meet obligations or disbursements of programs with grants from the U.S. Government, approved and pending receipt, and payment of contracts for capital improvements under construction, as allocations and determinations of State and Federal Courts are made effective.

- Emergency Fund: Fund to meet the needs caused by natural disasters such as: hurricanes, earthquakes, floods, droughts and others. It is capitalized annually by an amount not less than one percent of the total net revenues of the last fiscal year. The balance of the Emergency Fund will never exceed one hundred fifty million dollars.

- Public Debt Redemption Fund: Receives funding generated by taxes imposed on non-exempt property, equivalent to 1.03%, and General Fund contributions for the payment of principal and interest of the Central Government long-term debt.

- Urgent Interest Fund (FIA): Act No. 91 of 2006, as amended, authorized a sales and use tax for the first time in Puerto Rico. Act No. 91, also, created the Urgent Interest Fund which provides that each fiscal year the first receipts of the central government's sales tax, in the amount specified by law, be deposited in this dedicated fund and applied to the payment of the Sales Tax Revenue Bonds.

It is important to note the differences in the types of income of the budget and the use that can be given to each Fund. As an example, the Public Improvement Fund is used for the development of improvement works, such as construction of roads, buildings or rehabilitation of parks or recreational sites. Also, there are incomes which are resources that public corporations generate for their services and are used for operational expenses and development of improvements which are the responsibility of each Corporation, as well as particular uses arranged by law. The main source of the budget comes from the General Fund of the Commonwealth.

***Budget Resources Distribution***

The Budget defines the origin of resources and their distribution to various agencies and government offices. In terms of the origin of resources, the current budget: Fiscal Year 2015-2016 Government of Puerto Rico Consolidated Budget of the General Fund amounts to $9,800 million. Appendix 4-A includes data of the Consolidated Annual Budget for Fiscal Years 2013 to 2016.

The sources of origin of the resources are:

| SOURCE OF FUNDS | CURRENT BUDGET FY 2015-2016 *(Thousands)* |
|---|---|
| Joint Resolution - General Fund | 4,220,911 |
| Special Appropriations | 5,304,089 |
| Revenues from Financing | 0 |
| Other Funds | 275,000 |
| **Total** | **9,800,000** |

*Source: Office of Management and Budget*

The Agency expenses distribution reflects, in large part, public policy priorities of the State. While most government agencies include in their budgets projects related to emergency management or hazard mitigation, a group of agencies have been selected that are most relevant for the PEMPN. These agencies are: Emergency Management and Disaster Administration Agency, Department of Natural and Environmental Resources, Environmental Quality Board, Planning Board and Permit Management Office.

The budget for these agencies for years 2015 and 2016 are shown below.

## EMERGENCY MANAGEMENT AND DISASTER ADMINISTRATION AGENCY

| BUDGET<br>EMERGENCY MANAGEMENT AND DISASTER ADMINISTRATION AGENCY | | | |
|---|---|---|---|
| ***Source of Revenues*** | **Fiscal Year 2014-2015** | **Fiscal Year 2015-2016** | **Absolute Change** |
| *Joint Resolution General Fund* | 6,755,000 | 5,655,000 | -1,100,000 |
| *Special Appropriations* | 300,000 | 1,300,000 | 1,000,000 |
| *Federal Funds* | 4,747,000 | 4,593,000 | -154,000 |
| ***Total*** | **11,802,000** | **11,548,000** | **-254,000** |

*Source: Office of Management and Budget*

The AEMEAD consolidated budget for Fiscal Year 2015-2016 amounts to $11,548,000. This amount includes $5,655,000 from the Joint Resolution-General Fund, $1,300,000 from Special Appropriations and $4,593,000 in Federal Funds. Operational expenses reflect a reduction of $254,000 when compared to funds allocated in Fiscal Year 2014-2015. This decrease is mainly due to the public policy of expense reduction. In addition, it considers the effect of redistribution of the budget allocated for the payment to public corporations for services of the Aqueduct and Sewer Authority, Electric Power Authority, Public Buildings Authority and payment of Fidelity Bond Premiums ("Primas de Fianza de Fidelidad"). The Special Appropriations are $300,000 for operational expenses of the Puerto Rico Seismic Network and $1,000,000 to mitigate disasters.

The main contributing federal programs include: Emergency Management Performance Grants, Homeland Security Grant Program, Urban Train, and Earthquake Consortium and State Assistant. The funds correspond to operational and administrative assignments to the Emergency, Crisis, or Disaster Operations Program.

➢ **DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES**

| **BUDGET**<br>**DEPARTMENT OF NATURAL AND ENVIRONMENTAL RESOURCES** | | | |
|---|---|---|---|
| ***Source of Revenues*** | **Fiscal Year 2014-2015** | **Fiscal Year 2015-2016** | **Absolute Change** |
| *Joint Resolution General Fund* | 4,463,000 | 4,019,000 | -444,000 |
| *Special Appropriations* | 284,000 | 1,000,000 | 716,000 |
| *Other Incomes* | 2,500,000 | 0 | -2,500,000 |
| ***Total*** | **7,247,000** | **5,019,000** | **-2,228,000** |

*Source: Office of Management and Budget*

The DRNA consolidated budget for Fiscal Year 2015-2016 amounts to $5,019,000. This amount includes $4,019,000 from the Joint Resolution-General Fund and $1,000,000 from Special Appropriations. Operational expenses reflect a reduction of $2,228,000 when compared to funds allocated in Fiscal Year 2014-2015. This decrease is mainly due to the public policy of expense reduction. Special appropriations include $1,000,000 for design, mitigation and flood control projects.

## ➢ ENVIRONMENTAL QUALITY BOARD

| BUDGET<br>ENVIRONMENTAL QUALITY BOARD | | | |
|---|---|---|---|
| ***Source of Revenues*** | **Fiscal Year 2014-2015** | **Fiscal Year 2015-2016** | **Absolute Change** |
| **Operational Expenses** | | | |
| *Joint Resolution General Fund* | 6,083,000 | 7,083,000 | 1,000,000 |
| *Special Appropriations* | 700,000 | 0 | -700,000 |
| *State Special Funds* | 16,387,000 | 18,540,000 | 2,153,000 |
| *Federal Funds* | 10,770,000 | 10,770,000 | 0 |
| **Capital Improvements** | | | |
| *Federal Funds* | 17,677,000 | 17,677,000 | 0 |
| ***Total*** | **51,617,000** | **54,070,000** | **2,453 ,000** |

*Source: Office of Management and Budget*

The JCA consolidated budget for Fiscal Year 2015-2016 amounts to $54,070,000. This amount includes $7,083,000 from the Joint Resolution-General Fund, $18,540,000 from State Special Funds and $28,447,000 in Federal Funds. Operational expenses reflect a net increase of $2,453,000 when compared to funds allocated in Fiscal Year 2014-2015. This increase is mainly due to the appropriation of $1,000,000 with charge to the Joint Resolution for the payment of Matching Federal Funds, an increase of $2,153,000 in State Special Funds and the reduction of $700,000 in Special Appropriations. State Special Funds, that amount $18,540,000, are generated from fees for permits, fines, invoices,

publications and certified copies in accordance with Act. 416-2004, as amended. These resources are used for operational expenses of the Agency.

The main contributing federal programs include: Air Pollution Control Program Support, Performance Partnership Grants, Hazardous Waste Management State Program Support, and Capitalization Grants for Clean Water. It also includes federal funds for capital improvements projects to improve the quality of water supply. In relation to federal funds, it is important that on May 12, 2014, and after 13 years, the JCA achieved the elimination of the "High Risk" designation in the administration of federal funds under which it was in since 2001. This has allowed the Board to receive all pending reimbursements, which exceed $30.0 million. Conversely, for the first time in the operational history of the JCA, funds for the State Lead Program entered by means of advancement. This allows the Board to assume the obligations of the Program, without the need to require General Fund resources to meet them.

➢ **PLANNING BOARD**

| **BUDGET**<br>**PLANNING BOARD** | | | |
|---|---|---|---|
| ***Source of Revenues*** | **Fiscal Year 2014-2015** | **Fiscal Year 2015-2016** | **Absolute Change** |
| **Operational Expenses** | | | |
| *Joint Resolution General Fund* | 14,252,000 | 11,197,000 | -3,055,000 |
| *Special Appropriations* | 54,000 | 50,000 | -4,000 |
| *State Special Funds* | 1,350,000 | 1,330,000 | -20,000 |
| *Federal Funds* | 2,579,000 | 2,579,000 | 0 |
| **Subsidies, Incentives and Donations** | | | |
| *Special Appropriations* | 140,000 | 110,000 | -30,000 |
| ***Total*** | **18,375,000** | **15,266,000** | **-3,109,000** |

*Source: Office of Management and Budget*

The JP consolidated budget for Fiscal Year 2015-2016 amounts to $15,266,000. This amount includes $11,197,000 from the Joint Resolution-General Fund, $160,000 from Special Appropriations, $1,330,000 from State Special Funds and $2,579,000 in Federal Funds. As can be observed, operational expenses reflect a decrease of $3,109,000 when compared to funds allocated in Fiscal Year 2014-2015. This decrease is mainly due to the public policy of expense reduction. In addition, it considers the effect of the redistribution of the budget allocated for the payment to public corporations for services of the Public Buildings Authority and payment of Fidelity Bond Premiums ("Primas de Fianza de Fidelidad").

Special Appropriations are $50,000 for the operational expenses of the Castañer Development Consulting Group, $50,000 for the "Convenio de Delegación de Competencia al Municipio de Ponce" and $60,000 for the Cooperative Conjunction Agreement for the US Geological Survey.

State Special Funds are generated from fees for JP publications, documents o property studies. These resources are used for operational expenses, as established by Law. The main contributing federal programs include: Development Disabilities Basic Support and Advocacy Grants, Coastal Zone Management Administration Awards, Homeland Security Grant Program (FEMA) and Economic Development Assistance Program.

- **PERMITS MANAGEMENT OFFICE**

| BUDGET<br>PERMITS MANAGEMENT OFFICE | | | |
|---|---|---|---|
| ***Source of Revenues*** | **Fiscal Year 2014-2015** | **Fiscal Year 2015-2016** | **Absolute Change** |
| *Joint Resolution General Fund* | 6,403,000 | 5,402,000 | -1,001,000 |
| *Special Appropriations* | 2,373,000 | 180,000 | -2,193,000 |
| *State Special Funds* | 8,121,000 | 8,500,000 | 379,000 |
| ***Total*** | **16,897,000** | **14,082,000** | **-2,815,000** |

*Source: Office of Management and Budget*

The OGPe consolidated budget for Fiscal Year 2015-2016 amounts to $14,082,000. This amount includes $5,402,000 from the Joint Resolution-General

Fund, $180,000 from Special Appropriations and $8,500,000 from State Special Funds. Operational expenses reflect a decrease of $2,815,000 when compared to funds allocated in Fiscal Year 2014-2015. This decrease is mainly due to the public policy of expense reduction. In addition, it considers the effect of the redistribution of the budget allocated for the payment to public corporations for services of the Public Buildings Authority.

Special Appropriations are $80,000 for signs removal and $100,000 for the Transfer Agreement of ARPE to the Municipality of Ponce. State Special Funds are generated from service fees collected, permit payments and operational transactions, which vary according to the demand of service. These resources are used for operational expenses of the Agency, in accordance with Act. 161-2009.

As observed, specific funds are allocated for disaster mitigation in AEMEAD and DRNA budgets, demonstrating State commitment to meet the identified hazards. The analysis reveals that there were no specific mitigation allocation in the JCA, JP and OGPe, but these agencies ministerial duties systematically support hazard mitigation. The importance of the federal funds that are received and are considered part of the AMEAD, JCA and JP budgets must be highlighted. The total of federal funds for these three agencies, in the 2015-2016 budget, amounts to $35,619,000.

### 4.4.2 Federal Resources

The Federal Government has a wide range of programs that provide funds and offer technical assistance for activities and projects to mitigate natural hazards. Puerto Rico has

access to these programs and funds. The opportunity to attract federal funds for mitigation projects reinforces the capacity that Puerto Rico has to mitigate identified hazards. The federal funds for mitigation projects are, in general terms, described below, and funds that are not directly related to mitigation projects but for which assignments allow to carry out projects that benefit or support hazard mitigation and reduce vulnerability are also discussed.

- **HAZARD MITIGATION GRANT PROGRAM**

  The purpose of the HMGP is to reduce the future loss of life and property due to natural disasters; to implement state or local hazard mitigation plans; to enable mitigation measures to be implemented during the immediate recovery from a disaster; and to fund previously identified mitigation measures in order to benefit the disaster area. Projects grants can be awarded for activities such as acquisition, relocation, lifting and improvements to facilities and property in order for them to withstand future disasters.

- **FLOOD MITIGATION ASSISTANCE GRANT PROGRAM**

  The FMA helps states and communities to plan and conduct activities designed to reduce the risk of flood damage to buildings and structures insurable under the NFIP.

- **PRE-DISASTER MITIGATION GRANT PROGRAM**

  The objective of PDM is to continuously implement hazard mitigation projects to reduce overall risks to the population and structures in future risk events, while

also reducing reliance on federal funding in upcoming danger events. Examples of projects that can be conducted with PDM funds are: acquisition, demolition and relocation of vulnerable structures; installation of electric generators and storm shutters; development and updating of Mitigation Plans; educational campaigns and projects; infrastructure rehabilitation; and fire and flooding control projects, among other.

- **EMERGENCY MANAGEMENT PERFORMANCE GRANT PROGRAM**

The purpose of the Emergency Management Performance Grant (EMPG) Program is to assist in the preparation and management of all hazards and to obtain the resources required to support the National Preparedness Goal's. It also encourages the development of programs for the prevention of risks and hazards, including terrorism, and the improvement of planning and recovery capacity through the strengthening and revitalization of housing and infrastructure.

- **COMMUNITY DEVELOPMENT BLOCK GRANT**

The funds available under the CDBG allow, among others, to develop viable urban communities by providing decent housing and a suitable living environment. It is directed principally to benefit persons of low to moderate income. The community development activities can include acquisition, rehabilitation, reconstruction of properties and installations that have been damaged by disaster, and the redevelopment of areas affected by disasters.

- **FEDERAL HIGHWAY ADMINISTRATION AND FEDERAL TRANSIT ADMINISTRATION**

Provide assistance for the repair of roads built with federal funds. These resources are used to continue the development of a safe road system, using new technologies that improve the quality and lifespan of the roads.

- **NATIONAL DAM SAFETY PROGRAM**

The purpose of the NDSP is to improve public safety and mitigate disasters related to dam breakages through regulation programs, research to improve the expertise on the construction and rehabilitation of dams, and dam safety inspectors training.

- **EMERGENCY WATERSHED PROTECTION PROGRAM**

The purpose of the EWP is to provide technical and financial assistance to implement emergency measures in order to reduce run-offs and prevent soil erosion and protect life and property from floods, drought, erosion, landslides and basin sedimentation when natural hazards cause the sudden deterioration of the basin.

- **REGIONAL COASTAL RESILIENCE GRANTS PROGRAM**

The purpose of this program is to develop and implement activities that build resilience of coastal regions, communities, and economic sectors to the negative impacts from extreme weather events, climate hazards, and changing ocean conditions. The program helps to protect and preserve sensitive coastal areas and provides the benefit of reducing the development in high risk coastal areas.

➢ **NATIONAL COASTAL WETLANDS CONSERVATION GRANT PROGRAM**

The primary goal of the NCWCG is the long-term conservation of coastal wetlands through the conservation, restoration, acquisition and management of the wetlands due to their importance for the ecosystem, as they help in flood mitigation, soil erosion control, land stabilization through drainage maintenance and coastal areas sedimentation control, which act as a buffer zone against water contaminants and sustain an important biological diversity.

## 4.5 Advances, Challenges and Obstacles of the State Mitigation Capacity

As observed, there are a variety of State and Federal laws and regulations in Puerto Rico that regulate the State planning processes, including all those related to hazard mitigation. In addition, it has financial, state and federal resources that are annually allocated and others that the State, through its agencies, has the opportunity to obtain through federal proposal. On the other hand, it has analysis tools to study the impact of hazards, the change of the dangers and to estimate the vulnerability of the population and structures, among others. Laws and resources that are assigned to hazard management and mitigation reflect the strength and mitigation capacity of Puerto Rico to protect its inhabitants from disasters and to prevent them. However, it is important to identify the challenges or obstacles that the State can have to guarantee effective hazard mitigation.

### 4.5.1 Challenges and Obstacles of the State Mitigation Capacity

Although with the existing availability of legal, regulatory, financial and analysis resources, challenges and obstacles that can be improved to strengthen the processes and

State mitigation capacity have been identified. The aspects discussed below, that are necessary factors for the process of hazard mitigation, emerged from the process of analysis and updating of the PEMPN, as well as the review of literature on hazards and recommendations proposed in specialized technical studies. It is important to meet the challenges or obstacles that were identified in order to strengthen the State mitigation capacity.

- **Economic Situation of the State**

Although in the analysis carried out it does not arise that the country's fiscal crisis has reduced the assignments to specific funds for hazard mitigation, it is important to ensure that this does not happen given the possibility that the fiscal crisis will deepen. The public policy of expense reduction in Puerto Rico provides for measures which, although they do not directly reduce the budget, have impact on the hiring of staff, including related personnel to oversee the implementation of laws or regulations for planning or hazard mitigation. It is important that the country be aware that ignoring hazard mitigation could have consequences that affect social, economic and environmental sectors which could result in an overall detriment of mitigation actions and increase hazard vulnerability.

- **Implementation of Available Regulation**

Complexity and bureaucratic processes in the Agency on occasions delay the review and evaluation of the impacts of the projects proposed by developers. These delays have a direct impact on project costs which sometimes causes some developers to take the risk of developing projects without completing the formal

agency approval process. This has the consequence that there are projects that do not comply with the regulations and therefore general deterioration of environmental conditions of the surrounding areas arises.

When land use practices and development patterns decrease the ability of natural systems, sustainability of the natural system is reduced. In Puerto Rico, excessive sprawl has caused the reduction of natural resilience that wetlands, streams, rivers, beaches, dunes and mangroves provide. It has also exposed a greater number of communities to the effects of natural disasters. The expansion of unplanned development has dramatically increased the amount of impervious planar surfaces such as roads and parking spaces, which can increase the problem of flooding. Moreover, the development pressures in rural areas have precipitated this development in areas prone to hazards such as hills and mountain slopes. This type of development contributes to deforestation and reducing the absorption capacity of the soil when there is heavy rainfall, increasing the frequency of flash floods and landslides. In these situations, it is important to correctly implement the laws and regulations related to the planning and evaluation of projects, but in a way that does not penalize the developer by adding cost and time, which could cause informal constructions.

- **Coastal Zone Management**

The Coastal Zone Management Program and the Special Flood Hazard Areas Regulation (Regulation No. 13) have become important regulatory documents directly related to the mitigation of hazards in the Island due to the increasing

pressures for development of Puerto Rico's coastal areas and limited availability of land in the country. Unfortunately, the implementation of these policies of protection has not been constant. Coastal developments have caused the destruction of mangroves and coastal environments. The loss of these areas that act as natural buffers has made the coastal areas more vulnerable to damage caused by waves and coastal erosion, among others.

The coastal zone management is essential for the mitigation of hazards in Puerto Rico. As noted previously, 44 of 78 municipalities in Puerto Rico are coastal, representing 56% of the municipalities. On the other hand, there are ports, airports (including the Luis Muñoz Marín International Airport), roads, structures of all kinds, critical infrastructure and large population which are located in the coastal zone. Climate change, along with the characteristics or trends observed for years in the coasts of Puerto Rico pinpoint the urgency of correct implementation of the regulations related to coastal zones and floods.

- **Information flow and relationship between the public policies of development, planning and hazards mitigation**

  Although a contradiction between development, planning and hazard mitigation policies has not been directly identified, it is important to maintain a balance between public policies that promote economic development and the policies that seek to order the territory and reduce the vulnerability of natural hazards. Policies and established regulations suggest that there is an interrelationship between the agencies related to land-use planning/ordinance processes and hazard mitigation.

However this aspect could not be confirmed since there was diversity of laws, regulations and analyses. The interrelation of agencies and information flow is important so that efforts are not duplicated and ensure that hazard mitigation processes and actions are initiated in early stages of the analysis of plans and projects. It is important to enhance efforts to coordinate the interagency review, clarify primary and support functions, and oversee the implementation of laws to guarantee a balance between the processes of development, planning and hazard mitigation. This relationship must be based on a solid understanding of the environment, natural hazards and their potential impacts.

### 4.5.2 Advances of the State Mitigation Capacity

After the evaluation of changes or advances of the State mitigation capacity obtained during the term of the 2011 PEMPN, the following stand out:

- Approval of the Land-Use Plan, as described above, is an ordinance instrument which aims to establish a territorial model that serves as an urban, environmental and infrastructure development reference when proposing and conducting projects, plans and programs.

- Approval of the Joint Regulation, which details the permits processes related to the development and use of land, and integrates different planning regulations in a single document to uniform all processes.

- Analysis and development of work carried out by the Puerto Rico Climate Change Council (CCCPR) whose main objective is to assess the vulnerability of Puerto Rico and recommend response strategies to climate change.

The three aspects pointed out as major advances that had the State in its mitigation capacity during the effective period of 2011 PEMPN are fundamental because they meet the assessed recommendations to 2011 PEMPN and will benefit the implementation of the 2016 PEMPN. The approval of the Land-Use Plan and Joint Regulation seeks to maintain processes of review and approval of plans and projects in a coordinated manner. Both documents integrate processes or consideration of aspects to mitigate the hazards to which Puerto Rico is vulnerable, including climate change. On the other hand, the integration and development of the analysis work of the CCCPR demonstrate that Puerto Rico is conscious of the need to deal with and mitigate hazards identified in the 2011 PEMPN and updated in the 2016 PEMPN, including climate change. In this way, the State moves towards a greater understanding of the risks and management of the processes of spatial planning and hazards mitigation.

# CHAPTER 5: LOCAL COORDINATION AND MITIGATION CAPABILITIES

The integration and coordination of local mitigation planning is critical because PEMPN ensures that different levels of planning and hazard mitigation are complementary. The 78 municipalities of Puerto Rico locally developed mitigation plans. The Municipal Mitigation Plans pursue compliance with the public policy of the state, established in the Act No. 211 of August 2, 1999, as amended, that is *to protect our inhabitants in those emergency situations or disasters that affect the Commonwealth of Puerto Rico and to provide them with necessary assistance in the speediest and most effective manner possible to ensure the protection of their lives and property before, during and after the event*. In addition to meeting the public policy of the State, Municipal Mitigation Plans identify the hazards that are potentially exposed to the territory and its population, set goals, objectives and activities and projects to mitigate hazards, and define the process to implement the plan.

The structure and scale of the municipal government allow to recognize in greater detail the characteristics of its territory and therefore the dangers they may be exposed to, maintain more direct communication with residents and respond promptly in the case of hazard events caused by emergencies. In Puerto Rico the integration of local and state planning mitigation is constant due to the requirements and processes used for the development and implementation of all local mitigation plans and projects. In this chapter, the aspects that affect the coordination and capacity for local mitigation are discussed.

## 5.1 Resources for Planning and Hazard Mitigation at Local Level

Municipalities in Puerto Rico have resources and programs to locally address the hazard mitigation processes. These resources define the municipalities' mitigation capacity and strengthen the capacity of the State. Resources are discussed below.

### 5.1.1 Municipal Emergency Management Offices

The 78 municipalities of Puerto Rico have an operational and management structure that directs the work of mitigation and emergency response, this is known as the Municipal Office of Emergency Management (OMME), as provided by the Commonwealth of Puerto Rico Emergency Management and Disaster Administration Agency Act. These offices receive technical support from the State through the 12 AEMEAD Regional Offices.

Each OMME, as established by Act, is directed by a Municipal Director appointed by the Mayor, and is responsible for exercising the functions listed below.

- Developing and implementing the Emergency Management and Disaster Administration Plan. The Municipal Plan should be coordinated, as far as possible, with the State Plan.
- Fulfilling the requirements established in the Commonwealth Response Plan.
- Establishing mitigation, preparation, response and recovery efforts required for disaster control to minimize or prevent the loss of lives and properties.

- Undertaking the initial response to emergencies and disasters and coordinating with the pertinent municipal and Commonwealth agencies the actions and resources needed for the speediest recovery.
- Appropriate and use the necessary funds, enter into contracts, and obtain and distribute the equipment, materials and supplies needed for municipal emergency management operations.
- Establish a main control center and several secondary centers to direct municipal emergency management operations.
- Provide assistance to the personnel or to the property and equipment of any other municipality that may request assistance and that for any meritorious reason should receive the same.
- The mayor may accept donations for the purposes of the AEMEAD, of personal and real property, equipment, materials, services, supplies and money from any government entity, in or outside of Puerto Rico, and from private natural or juridical persons in or outside of Puerto Rico.

In addition to the functions that OMME exercised by Law, during the course of the years they have executed the following as part of routine operations:

- Provide training, in the following areas:
  - Operational Plans
  - First Aid
  - Emergency Management
  - Hazards: Hurricanes, Floods, Tsunami, Earthquakes, Terrorism and Hazardous Materials, among others

- Communications
- Shelters
- Exercises and drills
- Evacuation
- Rescue
- Community Emergency Response Teams (CERT)

➢ Distribution of information material to communities.

➢ Water distribution to sectors, which for some reason, are without service. Support to other agencies, such as the Fire Department for firefighting and Medical Emergencies in offering first aid.

The OMME, as directly related to emergency or disaster events in the municipalities, are essential in the process of reviewing Municipal and State Mitigation Plans due to their knowledge of areas most vulnerable to risks in their territory. On the other hand, over time, OMME has played a more active role in activities aimed to hazard mitigation through trainings and distribution of information material about dangers. Thus, they maintain an active role in processes of general public awareness of hazards and activities that can be done to mitigate their impact.

### 5.1.2 Municipal Territorial Ordinance Plans

The Autonomous Municipalities Act, Act No. 81 of August 30, 1991, provides provisions for municipalities to initiate a comprehensive regional planning process through the adoption of Territorial Ordinance Plans. Plans, as management tools of the municipal territory, shall protect the land, promote the balanced, beneficial and efficient use thereof and propitiate the thorough development of each municipality. As stated in Act No. 81,

as an indispensable instrument for the evaluation of the ordinance plans that are submitted to the consideration of the Planning Board, the public agencies concerned shall continually update and make available to said agency a physical inventory which shall include, among others, the location of the natural resources that should be protected, the use of the land, areas susceptible to natural risks, zones of agricultural, historical, archeological or tourist value, as well as a list of the infrastructure available.

According to data obtained from the Planning Board, 54 municipalities have completed their planning process for the approval of the POT and 24 are in various stages of the POT. The adoption of the POT requires a territorial analysis that, although was directed primarily to the process of planning and land management, translates into a fundamental tool for the mitigation of natural hazards. The classification and qualification instruments included in the Plans are central to regional planning and hazard mitigation.

In accordance with the Puerto Rico PUT, *classifying land is an action to establish categories of urban, developable and rustic land, knowing that in the subsequent process of developing or revising municipal plans or sectoral plans, specific qualifications with intensities and uses to be allowed in each of the categories would be established. The classification of urban or developable land does not assume that all land within these classifications can support construction or development. Within the classification of urban land there are rivers, streams, beaches, natural, ecological, agricultural areas at risk of flood or landslide, among others, that should not contain structures*. A very important aspect to highlight is that the PUT indicates *the analysis undertaken by the Planning Board is evidence that a significant part of the territory* **does not have the**

**appropriate qualifications to protect the ecological, natural, forest, risk areas etc.** (Emphasis supplied.) *The Board informed the municipalities that as part of the conciliation process with the Land Use Plan, districts must assign appropriate classification and objectives that are promulgated in the Land Use Plan.* For POTs to directly benefit hazard mitigation, it is crucial to analyze and assess all territorial components to determine conservation areas and the sectors most vulnerable to hazards.

Meanwhile the score or zoning is the instrument with which land uses are designated. Through qualification, the intensity of land use, building size and population density is regulated. Zoning also recognizes demographic changes and development patterns. Both planning, classification and qualification tools are essential to hazard mitigation because they can regulate and guide the development to less vulnerable areas.

### 5.1.3 Municipal Mitigation Plans

The municipalities of Puerto Rico prepare Municipal Mitigation Plans as required by the federal law *Disaster Mitigation Act* of 2000, known as the *Robert T. Stafford Disaster Relief and Emergency Assistance Act*. This law requires state and local governments to adopt mitigation plans against natural hazards in order to be eligible for disaster mitigation funds under the FEMA's *Hazard Mitigation Grant Program*. In March 2016, 76 of the 78 municipalities in Puerto Rico have their Municipal Mitigation Plans approved by FEMA and adopted by the municipalities. Municipal Mitigation Plans are intended to detect hazards that affect the municipal territory and identify mitigation measures in order to reduce loss of life and property. Municipal Mitigation Plans are the main instrument of hazard mitigation at the municipalities, the relationship and

integration of these to the State Mitigation Plan, the Territorial Ordinance Plans and to the Emergency Management Municipal Offices strengthen and make the mitigation capacity at the local and state level more effective.

In addition to the previously discussed aspects, some municipalities have area plans that aim to understand particular situations in a sector. It is also important to note that the 44 coastal municipalities of Puerto Rico are certified as TsunamiReady and have maps and corresponding evacuation plans.

## 5.2 Review and Approval Process of Municipal Mitigation Plans

The process that the State, through the GAR, has followed in the past 13 years for the advice, coordination, review and approval of Municipal Mitigation Plans is described below.

- Offering introductory workshops on the Updating and Review of Local Mitigation Plans.
- Tracking, in coordination with FEMA and the GAR, of the various municipalities in terms of the steps taken to prepare the Municipal Mitigation Plan and identifying resources for funding.
- Evaluation of monthly and quarterly progress reports to the Office of the GAR and FEMA by municipalities. These reports detail the sections of the Plan, with its respective code designated by the "DMA Act 2000" and the percent that has been completed. They also include a detailed description of the tasks performed for each section. The end of the report summarizes the progress of plans and details the problems encountered and/or the assistance

needed. Appendix 5-A presents the Monthly and Quarterly Progress Report Form that the Municipalities submit to the Office of the GAR and FEMA on Local Mitigation Plans.

- The GAR reviews and evaluates the quarterly reports submitted by municipalities, and then sends these to FEMA Region II, through the Caribbean Division, to conduct the corresponding evaluation of the status / progress of the plans. Consequently, it will be determined if they need technical assistance.

- Once the report is approved, municipalities with federal funds submit the refund request to the Office of the GAR with the corresponding invoices and disbursement vouchers to process the refund.

- Usually depending on the requirements of the mitigation program which is subsidizing the update of the Plan, the Municipalities have 36 months to complete the Local Mitigation Planning project.

- Once the Local Mitigation Plan is completed, the plan must be adopted by Executive Order of the Mayor or by Resolution of the Municipal Assembly. The document is sent to the Office of the GAR for review by the mitigation staff. If the Plan meets FEMA requirements and is deemed compliant by the staff, it will be processed for final review and approval. If not compliant or lacks information, among other aspects, the plan is returned to the municipality to incorporate pertinent corrections / recommendations.

- Upon FEMA's final review and approval, the division sends an approval letter to GAR and it notifies the Municipality. Once the adoption and approval process is completed, municipalities begin the process of implementing the Local Mitigation Plans.

### 5.2.1 Planning for the Review and Update of Municipal Mitigation Plans

As noted above, as of March 2016, a total of 76 of the 78 municipalities in Puerto Rico have their Mitigation Municipal Plans approved by FEMA and adopted by the local government. Therefore, 97 percent of the municipalities have approved their plans and only 2 municipalities (3%) have expired plans. Twelve of the municipalities that have approved plans are in process of revision and updating.

In compliance with the requirements of the Code of Federal Regulations 44CFR Part 201.6, the local mitigation plans are valid for five years. Taking into consideration the revision of Mitigation Plans, municipalities are required to begin their review and update efforts at least one year before the expiration date of their plans. Consequently, enough time is allowed to complete the review process, public discussion and approval of plans before the end of the period of validity.

Because a Local Risk Mitigation Plan is required for the 78 municipalities, there are multiple effective dates. This requires that the GAR keep communication with the municipalities in order to ensure compliance with the dates and requirements of law. Appendix 5-B includes information about the status, effective period and the date that the municipalities should begin the updating of the local mitigation plans.

### 5.2.2 Integration of Municipal Mitigation Plans to the State Mitigation Plan

The incorporation of the mitigation plans to the State Plan is a complex endeavor that aims to provide uniformity to a cluster of plans containing multiple levels of analysis and details used at their development stage. As part of the State Plan update, copies of 64

municipal mitigation plans[14] were obtained and then proceeded to be read, reviewed and the main findings of each plan were summarized. This effort is intended to analyze and take into consideration the policies, goals, objectives and mitigation activities of the local plans.

The review of municipal plans focused in identifying the following areas:

1. Natural hazards that can affect municipalities
2. Estimate of potential losses associated with identified risks
3. Mitigation goals or general objectives set by the municipality
4. Mitigation activities or projects proposed by the municipality to deal with the natural hazards identified

Appendix 5-C, Summary of Municipal Mitigation Plans shows the most outstanding data of each Plan.

The identification of natural hazards that can affect municipalities and the estimate of potential losses associated with identified risks allowed to establish which hazards have greater physical and economic impact. Overall it was observed that the municipalities are being proactive in developing actions and mitigation projects in the following five categories: 1) prevention, 2) protection of property, 3) protection of natural resources, 4) structural projects, and 5) public information and education. This approach has enabled municipalities to meet a higher percentage of the shares or projects proposed in the local mitigation plans because they do not rely solely on physical or structural projects.

[14] As of August 2015, the corresponding agencies provided 64 copies of the 76 approved plans.

## 5.3 Allocation of Funds and Technical Assistance to Municipalities for the Development of Local Mitigation Projects

This Section describes the procedure that has been used to provide technical assistance and allocate funds to municipalities for the development of local mitigation projects in the last five years. Upon review of the PEMPN it is estimated that the process will remain the same during the period of implementation of the 2016 PEMPN.

### 5.3.1 Process of Grant Funding and Technical Assistance to Municipalities for the Development of Local Mitigation Plans and Projects

#### 5.3.1.1 Financial Assistance and Grant Funding

The process to develop the Municipal Mitigation Plan review begins when the GAR, AEMEAD and/or FEMA provide guidance to municipalities on the provisions of the "Disaster Mitigation Act" of 2000 and the requirements and availability of funds from various FEMA programs, among other aspects. Funds received by municipalities are mainly from two FEMA programs: 1) *Hazard Mitigation Grant Program* (HMGP) and 2) *Pre-Disaster Mitigation* (PDM).

The Office of the GAR, its mitigation staff and the Mitigation Division of the AEMEAD also offer technical assistance to municipalities in the application of funds and preparation of proposals to complete the mitigation plans. Once municipalities complete the proposal requirements and the request for funding, they submit it to the Office of the GAR. The GAR proceeds with the evaluation of proposals and, if in compliance with all requirements, endorses them and submits the proposals to FEMA. Once FEMA receives the endorsed proposals, it evaluates and processes the approval of funding to finance the preparation of municipal

mitigation plans. After municipalities have obtained approval of funding, they proceed to hire external resources according to legal procedures for the preparation of mitigation plans. Some municipalities choose to complete part of the plan's requirements with domestic resources.

In addition to HMGP and PDM funds provided by FEMA, the Office of the GAR coordinates other funding sources, including state and municipal funds, to provide the 25% match required by federal programs to fully fund development of the Municipal Mitigation Plans. In the event that a municipality is not eligible for FEMA funds to develop the mitigation plan it must identify alternative funding sources.

Importantly, regardless of the funding source used for the preparation of Municipal Mitigation Plans, the Office of the GAR and AEMEAD, in coordination with FEMA, provide guidance and technical assistance in the preparation of plans and set the requirements for their preparation and approval. The procedures have been developed under the provisions of the Disaster Mitigation Act of 2000 (DMA2000) and the guidelines prepared by FEMA for these purposes.

Title 44 of the Code of Federal Regulations, through Section 322 requires that the State, through its Representative, and FEMA take responsibility for reviewing and approving mitigation plans even when they are fully funded by the municipality. This is required because municipal plans must be integrated and be in harmony with the State Mitigation Plan. On the other hand, in case of natural disasters,

FEMA provides a significant amount of money to mitigate its effects. For this reason, FEMA, through the "Disaster Mitigation Act of 2000" (DMA 2000), requires that the territories have an approved mitigation plan with the features described in the Act as a compulsory condition for receiving funding to address natural disasters.

The criteria used to approve the proposals for the various mitigation projects outlined in the municipalities' local plans vary according to the requirements of the subsidy program for risk mitigation grant funding. However, most of FEMA programs, such as HMGP, PDM and FMA, require that proposals submitted by municipalities for the qualification of funds include or consider the following aspects:

- Information on the number and amount of damages and/or repetitive losses of properties caused by flood events.
- Cost-effectiveness analysis of the projects that reflect a substantial reduction of damages and future losses.
- Demonstrate that proposed projects are in harmony with the State Mitigation Plan.
- Demonstrate compliance and consistency with parts 9 and 10 of Title 44 Code of Federal Regulations; these are Management Areas Susceptible to Flooding and Environmental Considerations, respectively.

- No federal assistance should be duplicated with another federal program; that is, if a project is being funded by another federal agency like the U.S. Corps of Engineers it should not be assigned FEMA funds for that Project.
- The community to carry out the Project should not be on probation under the *"National Flood Insurance Program"*.
- The granting of funds from FEMA to develop municipal plans requires matching funds; FEMA provides 75 percent and municipalities must provide 25 percent of the cost of the Plan.

Once the funds are granted and the process of developing programs and projects or drafting mitigation plans has started, municipalities must submit monthly and quarterly progress reports to the Office of the GAR and FEMA. These reports are reviewed by the Office of the GAR and FEMA, separately. They allow the Office of the GAR and FEMA to know the projects status, identify and address technical assistance needs and guide the drafting of plans, and the design and implementation of mitigation projects. Appendix 5-D contains a table indicating the status and source of funding of municipal plans.

#### 5.3.1.2 Technical Assistance

During the process of drafting Municipal Mitigation Plans, the GAR, the mitigation staff of GAR, and the AEMEAD Mitigation Division provide guidance and technical assistance to municipalities. The Office of the GAR uses 10 percent of the funds of the "Pre-Disaster Program" (PDM) to provide technical assistance

to municipalities. Technical assistance is offered through workshops focused on providing guidance to municipalities on the application of funds and the requirements for preparing mitigation plans. In addition to the orientation workshops, support is provided in the following areas:

- Proposal writing
- Compliance with applicable laws and regulations
- Coordination with State and Federal agencies to obtain data and information necessary to draft proposals and plans
- Access to databases such as HAZUS, maps, geographic information systems (GIS), technical studies and other sources of information in the assessment and inventory of hazards affecting the municipality.
- Identification of resources to assist municipalities in the preparation of plans, including studies conducted by the institutions on topics related to natural hazards, vulnerability and mitigation measures. Some of the institutions offering support are: Puerto Rico Seismic Network; National Meteorological Center; U.S. Corps of Engineers; U.S. Rural Development Administration; U.S. Fish & Wildlife; U.S. Geological Survey; Bureau of Historic Preservation; Planning Board; Metropolitan University (UMET); University of Puerto Rico, Río Piedras and Mayagüez campuses; Graduate School of Planning and School of Environmental Sciences at UPR-Río Piedras; and College of Engineers and Surveyors. This participation

facilitates access to technical information for the preparation of plans, studies and proposals for funding of mitigation projects.

- Assistance in filing required documents and quarterly reports.
- Audits, recommendation and refund process

### 5.3.1.3 Coordination of Funding Sources Allocation for the Implementation of Mitigation Plans and Projects

The development and implementation of local mitigation plans and projects involve identifying, processing and allocating resources, especially financial resources. The Office of the GAR and its mitigation staff have primary responsibility in this process for which, in general terms, the following tasks are performed:

- ➢ Identify state and federal programs that can be used to finance mitigation activities or projects.
- ➢ Inform municipalities about the availability of funds.
- ➢ Provide technical assistance in preparing grant applications or proposals as necessary.
- ➢ Address priorities in the implementation of mitigation projects, based on availability of funds.
- ➢ Monitor the development of mitigation projects and activities in terms of effective use of funds or the need for additional funds.

## 5.4 Defining Priorities for Distribution of Funds and Technical Assistance to Municipalities

In the FEMA-State Agreements it is concurred that the State / Territory sets priorities for distributing the funds that are available to support mitigation projects. It is important to note that this process is intended to plan and should not be used to deny the allocation of funds or assistance to a municipality. Likewise, it must comply with specific emergency situations that may occur. Priorities and processes established in the PEMPN do not invalidate or supersede the qualification criteria established by each federally funded program or other FEMA regulations with which the State must comply.

### 5.4.1 Methodology for Setting Priorities in the Allocation of Funds and Technical Assistance to Municipalities

Once the availability of funds is known, the process to provide technical assistance and report availability should be as follows:

- Send letters to municipalities to inform them about the availability and characteristics of technical and economic resources to implement mitigation activities and projects, and summon the mayors or their representatives to participate in briefing.

- Celebration of meeting / briefing on available resources, where the aspects to be discussed, among others, are:

  - Description of available funds
  - Criteria to qualify
  - Proposal submission deadline

- Process for proposal submission
- Issues to be considered for inclusion in the proposal
- Tools available to review compliance with the writing of the proposal

Once the proposals are received and evaluated, the criteria that will be considered to prioritize the funds available is as follows:

- ***Main Criteria***
  - Municipalities' compliance with **all the requirements** of the fund or program available.
  - Municipalities' compliance with the deadlines established to evaluate and submit proposals.
  - Inclusion in the Local Mitigation Plan of the mitigation project to be executed. Except for the occurrence of an emergency situation or a in the Local Mitigation Plan situation not covered by the Plan because it occurred **after** the approval of the Local Mitigation Plan.
  - Results of cost-benefit analysis and other analyses that demonstrate the extent to which the benefits are maximized with the project to be developed. This analysis helps to determine which of the proposed projects yield the greatest benefits in relation to their costs, so that it translates into a major criterion for prioritizing projects. The greater economic, social and environmental benefits, greater priority to approve the proposals and allocate funds as society net profits are maximized.

- ***Secondary Criteria***

  - Priorities identified by the municipalities in their Municipal Mitigation Plans and compliance with the *National Priorities List*, established in the Federal Register in accordance with the DMA 2000.

  - Results of vulnerability analysis conducted by the municipalities as part of the Local Mitigation Plans.

  - Results of the municipality's vulnerability analysis conducted as part of the review of the 2016 PEMPN. Chapter 2: Hazard Assessment includes Appendix 2-C which shows the Vulnerability to Natural Hazard Tables for the municipalities. For the vulnerability analysis, a range was established by municipality based on the number of people living ~~in~~ there that was estimated would be potentially exposed to levels of "Very High" and "High" vulnerability of each natural hazard.

    These ranges are defined from 1 to 78 for the 78 municipalities. The range obtained is included in the table as the point corresponding to each municipality. It is important to indicate that the scale used is reversed because a lower score represents a higher priority. This is so because in the ranges established in the analysis of natural hazards, range "1" represents the municipality with the highest number of people potentially exposed to higher levels of risk.

This scoring system for each category of vulnerability is obtained from the susceptibility maps that were developed as part of the Hazard Assessment. Based on the results of the vulnerability tables, the team developed a Prioritization Matrix for the Distribution of Funds and Technical Assistance to Municipalities to implement its mitigation projects. The Prioritization Matrix, included in Appendix 5-E, establishes in an objective manner the following five categories:

1) *Very High Vulnerability.................121 a 190 points*
2) *High Vulnerability .........................191 a 255 points*
3) *Moderate Vulnerability..................256 a 320 points*
4) *Low Vulnerability...........................321 a 385 points*
5) *Very Low Vulnerability..................386 a 450 points*

These categories define the priority of the municipalities based on the estimated exposure of the population for each of the hazards assessed. The table below summarizes the total score and the category of vulnerability for each municipality.

## MUNICIPALITIES' VULNERABILITY AND PRIORITY TO RECEIVE FUNDS AND TECHNICAL ASSISTANCE

| MUNICIPALITIES | GLOBAL VULNERABILITY RATING | TOTAL SCORE |
|---|---|---|
| Adjuntas | *High Vulnerability* | 291 |
| Aguada | *Very High Vulnerability* | 166 |
| Aguadilla | *High Vulnerability* | 234 |
| Aguas Buenas | *High Vulnerability* | 283 |
| Aibonito | *High Vulnerability* | 253 |
| Añasco | *High Vulnerability* | 259 |
| Arecibo | *Very High Vulnerability* | 163 |
| Arroyo | *High Vulnerability* | 318 |
| Barceloneta | *High Vulnerability* | 291 |
| Barranquitas | *High Vulnerability* | 243 |
| Bayamón | *Very High Vulnerability* | 127 |
| Cabo Rojo | *High Vulnerability* | 209 |
| Caguas | *High Vulnerability* | 199 |
| Camuy | *High Vulnerability* | 307 |
| Canóvanas | *High Vulnerability* | 240 |
| Carolina | *Very High Vulnerability* | 187 |
| Cataño | *High Vulnerability* | 250 |
| Cayey | *Very High Vulnerability* | 177 |
| Ceiba | *Very Low Vulnerability* | 387 |
| Ciales | *High Vulnerability* | 258 |
| Cidra | *High Vulnerability* | 220 |
| Coamo | *High Vulnerability* | 319 |
| Comerío | *High Vulnerability* | 247 |
| Corozal | *High Vulnerability* | 289 |
| Culebra | *Very Low Vulnerability* | 448 |
| Dorado | *High Vulnerability* | 239 |
| Fajardo | *High Vulnerability* | 248 |
| Florida | *Low Vulnerability* | 372 |
| Guánica | *High Vulnerability* | 320 |
| Guayama | *High Vulnerability* | 196 |

| MUNICIPALITIES | GLOBAL VULNERABILITY RATING | TOTAL SCORE |
|---|---|---|
| Guayanilla | *Low Vulnerability* | 345 |
| Guaynabo | *High Vulnerability* | 251 |
| Gurabo | *Low Vulnerability* | 335 |
| Hatillo | *High Vulnerability* | 218 |
| Hormigueros | *Low Vulnerability* | 354 |
| Humacao | *High Vulnerability* | 245 |
| Isabela | *High Vulnerability* | 265 |
| Jayuya | *High Vulnerability* | 294 |
| Juana Díaz | *High Vulnerability* | 236 |
| Juncos | *Low Vulnerability* | 347 |
| Lajas | *High Vulnerability* | 319 |
| Lares | *Low Vulnerability* | 329 |
| Las Marías | *Very Low Vulnerability* | 404 |
| Las Piedras | *Low Vulnerability* | 381 |
| Loíza | *High Vulnerability* | 257 |
| Luquillo | *High Vulnerability* | 284 |
| Manatí | *High Vulnerability* | 294 |
| Maricao | *Low Vulnerability* | 359 |
| Maunabo | *High Vulnerability* | 280 |
| Mayagüez | *Very High Vulnerability* | 131 |
| Moca | *High Vulnerability* | 253 |
| Morovis | *High Vulnerability* | 308 |
| Naguabo | *High Vulnerability* | 219 |
| Naranjito | *High Vulnerability* | 257 |
| Orocovis | *High Vulnerability* | 300 |
| Patillas | *High Vulnerability* | 223 |
| Peñuelas | *Low Vulnerability* | 368 |
| Ponce | *Very High Vulnerability* | 190 |
| Quebradillas | *Low Vulnerability* | 369 |
| Rincón | *High Vulnerability* | 286 |
| Río Grande | *High Vulnerability* | 250 |
| Sabana Grande | *High Vulnerability* | 317 |

| MUNICIPALITIES | GLOBAL VULNERABILITY RATING | TOTAL SCORE |
|---|---|---|
| Salinas | *High Vulnerability* | 314 |
| San Germán | *High Vulnerability* | 296 |
| San Juan | *High Vulnerability* | 217 |
| San Lorenzo | *High Vulnerability* | 293 |
| San Sebastián | *Low Vulnerability* | 326 |
| Santa Isabel | *Low Vulnerability* | 380 |
| Toa Alta | *High Vulnerability* | 280 |
| Toa Baja | *High Vulnerability* | 228 |
| Trujillo Alto | *High Vulnerability* | 307 |
| Utuado | *High Vulnerability* | 220 |
| Vega Alta | *High Vulnerability* | 278 |
| Vega Baja | *High Vulnerability* | 224 |
| Vieques | *Very Low Vulnerability* | 449 |
| Villalba | *High Vulnerability* | 291 |
| Yabucoa | *High Vulnerability* | 220 |
| Yauco | *High Vulnerability* | 289 |

- Availability of Geographic Information System (GIS) in the Municipality. GIS is an analytical tool that integrates various levels of information on a geographical basis. The lack of accessibility to a GIS puts the municipality at a disadvantage with other municipalities that do have this system. GIS allows the municipality to make system with natural hazard assessment for the territory available and accessible at all times, which is an important tool to design and make informed decisions about:

  ✓ Land use planning

  ✓ Design of special projects for mitigation in areas of greatest vulnerability

- ✓ Drafting and implementation of ordinances aimed to mitigate natural hazards.
- ✓ Identify conflicting uses of land that hinder natural hazard mitigation and helps develop strategies to avoid future conflicts
- ✓ Evaluate and determine the impact of an event of danger in the territory

- Availability of Municipal Funding for mitigation activities or projects. Some municipalities have funds available for mitigation activities and projects identified as priorities. This is a criterion that must be taken into consideration when allocating resources, especially in matching funds requirements.

- Municipal Planning Office, because it has the following advantages and/or opportunities in the process of developing and implementing mitigation measures:
  - ✓ Conduct or supervise the preparation of a Territorial Ordinance Plan (POT, for its acronym in Spanish) and integrating natural hazard assessment into it.
  - ✓ Implement the POT properly
  - ✓ Design Area Plans with a focus on natural hazard mitigation to protect life and property of citizens.
  - ✓ Manage the GIS program

## 5.5 Advances, Challenges and Obstacles of the Local Mitigation and Coordination Capacity

Challenges, obstacles and advances that have been identified in the review process of the 2016 PEMPN regarding local mitigation coordination capacity are discussed below.

### 5.5.1 Challenges and Obstacles of the Local Mitigation and Coordination Capacity

In assessing the challenges and obstacles of local mitigation and coordination capacity the following are observed:

➢ ***Availability of funds to develop mitigation projects***

The main challenge or obstacle identified is related to the availability of funds to develop mitigation projects. During the term of PEMPN most funds available have been used for developing Municipal Mitigation Plans and not for the actions or mitigation projects established in the plans. This may be because in 2011 there was a high number of municipalities that did not have an approved mitigation plan. However, the allocation of funds for the development of actions or mitigation projects is essential to increase local mitigation capacity and reduce vulnerability to identified risks. Thus, Municipal Mitigation Plans from being just a document to comply with the DMA 2000 are turned into real hazard mitigation instruments, advancing from the planning stage to implementation.

➢ ***Adoption of Municipal Mitigation Plans***

Another identified obstacle is that municipalities either because they do not receive the allocation of funds or do not start the process of reviewing the Plan on

time, are devoid of a Local Mitigation Plan during a certain period. For this reason, it is necessary to increase state and local coordination so that municipalities always have an existing Plan.

### 5.5.2 Advances of the Local Mitigation and Coordination Capacity

In assessing the ability of local mitigation and coordination processes it is observed that the municipalities have an orderly system that identifies the hazards to which they are exposed to and alternatives to mitigate them. The size of the territory at local level allows addressing the dangers more directly. The most important advances achieved by the municipalities during the term of the 2011 PEMPN are indicated below.

- ***Municipal Mitigation Plans***

  Advances in the adoption and approval of Municipal Mitigation Plans is considered as the most important and demonstrates the mitigation capacity developed by the municipalities and coordination established between the local process and the state level. At the 2011 PEMPN there were 41 Municipal Mitigation Plans approved, 33 municipalities were in the process of reviewing the Mitigation Plans and 4 municipalities had not submitted their plans. These numbers contrast sharply with those of the 2016 PEMPN where 76 municipalities have Mitigation Plans approved and the two municipalities that, in March 2016, did not have an approved Mitigation Plan, are under review.

- ***Territorial Ordinance Plans***

The increase in the approval and adoption of the POT at the municipal level has been another important advance during the term of the 2011 PEMPN. According to data obtained from the Planning Board, as of March 2016, 54 municipalities have approved their Territorial Ordinance Plans and 24 municipalities are in various stages of approval of the POT. However, in 2011 the municipalities with approved POT were 42 and 36 were in various stages of approval of the POT. The increase in the adoption of POT strengthens local mitigation capacity and enables the coordination of planning processes at statewide level through the Puerto Rico Land Use Plan.

- ***TsunamiReady***

By 2011 only 19 coastal municipalities were TsunamiReady. As of March 2016, the 44 coastal municipalities of Puerto Rico are Tsunami Ready and have maps and Tsunami evacuation plans. This aspect strengthens the capacity of coastal municipalities to mitigate the danger of tsunamis.

- ***Incorporation of New Hazards***

Municipal Mitigation Plans that have gone through the process of reviewing the plan have begun to include new hazards such as fire, drought and climate change. Moreover, mitigation actions have been identified in the areas of prevention, protection of property, protection of natural resources, structural projects and public information and education. This approach has enabled municipalities to

meet a higher percentage of the actions or projects proposed in local mitigation plans, because they do not rely solely on physical or structural projects.

The above-mentioned aspects, in conjunction with the experience developed by municipalities to respond to emergency situations and analyze new information on hazards and mitigation, has the effect of increasing knowledge and strengthening local capacity.

# CHAPTER 6: PROCESS OF REVIEW, EVALUATION, AND IMPLEMENTATION OF THE PLAN

In order to periodically assess progress in the implementation of PEMPN, the implementation process includes stages of updating and maintenance. To be more effective in its goal of reducing the risks imposed by natural hazards, the PEMPN should be tempered demographic, economic and land use changes, among others affecting the country. Also, it is necessary to keep an update on the potential impacts of natural hazards so that adjustments can be made to strategies and priorities established in the Plan and how it is projected into the future, in the short and medium term. The process to maintain the Plan and monitor the mitigation activities proposed is discussed in the following sections.

## 6.1 Methodology and Monitoring of PEMPN

The monitoring program of the 2016 PEMPN has maintained most of the procedures set out in the 2011 PEMPN. Changes in the organization and frequency of monitoring tasks for the development of mitigation activities have been incorporated, based on the experience from the implementation of activities and mitigation strategies presented in the 2011 PEMPN, recommendations of the "State Mitigation Plan Review Guide" of FEMA, effective March 6, 2016, and the increase from three to five years in the term of PEMPN, due that it imposes to establish mechanisms that maintain the effectiveness and monitoring of the Plan for a longer period of time.

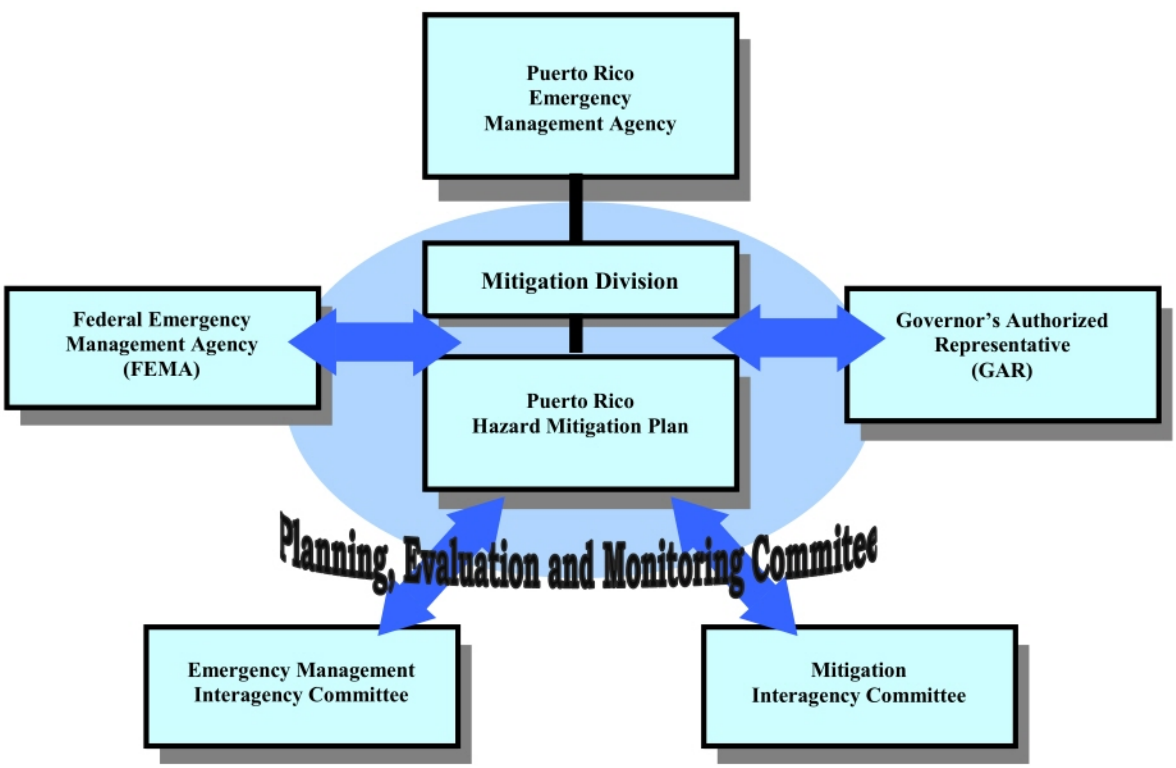
Activities related to monitoring, evaluation and updating of the Plan will continue to be the responsibility of the AEMEAD Mitigation Division, in coordination with the Office of the GAR

and members of the Mitigation Committee. In addition, the Office of the GAR will monitor the effective period and manage the financing of the Municipal Mitigation Plans. The GAR has created a central repository where existing electronic and printed copies of the Municipal Mitigation Plans are maintained. This allows the proper monitoring of plans by local officials and centralizes the custody of official documents in the State. The AEMEADs Mitigation Division is the central body coordinating the efforts and mitigation activities and has the organizational mechanisms to maintain effective communication with government agencies (State and Federal) and the municipalities. As part of the routine tasks of the unit, the Mitigation Division will provide regular monitoring on the implementation of the PEMPN. As described in Chapter 1, both the Interagency Committee for Mitigation of Natural and Technological Disasters and the Emergency Management Committee held regular meetings to address issues of mitigation and emergency management. These committees have the legal authority as they have been officially created by executive order of the Governor and the participation of more than 50 government agencies that have direct or indirect responsibility in emergency management and the implementation of mitigation projects and activities. As a follow-up mechanism in the implementation phases of PEMPN, it is proposed that this be a fixed item at regular meetings held by the Mitigation Committee members. In addition, it has developed an Interagency Agreement between the AEMEAD and FEMA where a compromise is set to hold a consultation program, where at least once a year, representatives of agencies related with PEMPN will meet to discuss the achievements, scope, limitations and needs, among other important aspects that are identified. See copy of the Interagency Agreement in Appendix 6-A.

To achieve an effective monitoring of the PEMPN, an organization has been defined that will coordinate the AEMEAD Mitigation Division and will incorporate frequent input from the two core committees, Mitigation and Emergency Management, especially in the event of an emergency situation or disaster event during the effective period of the Plan. In addition, the AEMEAD Mitigation Division will maintain close coordination and communication with the GAR and FEMA. The coordinated effort of all components previously defined will act as a Planning, Evaluation and Monitoring Committee of the PEMPN. Diagram 6.1 presents the key components to maintain an effective monitoring of the PEMPN.

**DIAGRAM 6.1**

**ORGANIZATIONAL CHART**
**PLANNING, MONITORING, EVALUATION AND UPDATING OF THE 2016 PEMPN**



According to requirements of law, once the PEMPN update is completed, it is submitted for review and approval by FEMA. By obtaining the approval of FEMA, the Plan is formally adopted by the state government and the implementation process starts. It states that within three months from completion of the approval and adoption process, the AEMEAD Mitigation Division will formally structure tasks for the Planning, Evaluation and Monitoring Committee. It has been recommended that the Mitigation Division assigns a resource or fixed appointment whose main responsibility is coordinating the implementation of the PEMPN activities.

The Mitigation Division is responsible for providing an Annual Progress Report of the Implementation of the PEMPN to the Governor. This report will be submitted before April 30 of each year, as established by Executive Order of the Governor adopting the review of the PEMPN. The report will discuss the progress of PEMPN, with emphasis in the compliance status of the Mitigation Strategy (goals, objectives and mitigation activities). In addition, amendments and resources necessary to fulfill Mitigation Strategy, among other issues, will be discussed. Appendix 6-B: Progress Report of the State Natural Hazard Mitigation Plan (Monitoring Sheet No. 1) shows a standard format that includes the basic elements to be included in the annual report.

The proposed monitoring system to provide ongoing review of progress towards the goals set forth in the Mitigation Strategy of the PEMPN consists of the following main components:

- Effectiveness of the planning process
- Effectiveness of the mitigation measures

- Effectiveness of the implementation of Local (Municipal) Mitigation Plans

- Significant changes in land use patterns and changes in the socioeconomic conditions of the Island such as migration patterns and redistribution of community locations.

- Evaluation regarding the impact of a new natural disaster, if any occurs.

- Keep the public informed and encourage its participation.

### 6.1.1 Evaluation of the Effectiveness of the Planning Process

The review of the planning process offers the opportunity to verify how mitigation activities have been integrated into the administrative processes of AEMEAD and agencies responsible for their implementation. This review will result in the identification of procedural areas that need to be modified. The areas to be considered in evaluating the effectiveness of the planning process are described below.

#### 6.1.1.1 Evaluation of Components of the Planning Committee

The Planning, Evaluation and Monitoring Committee will evaluate the need to incorporate new members to its team, whose experience and expertise will help to effectively monitor the implementation of the Plan. These new members may be citizens and members of professional organizations or academic institutions, among others identified as necessary. In addition, the Committee will evaluate and take into consideration the processes used (memoranda of understanding, interagency agreements, progress reports, distribution of minutes, etc.) to engage and inform agencies, private sector and the general public on processes, activities

and projects established to mitigate and reduce the losses of life and property. The Committee will also evaluate alternative of financial, technical, and human resources necessary for the implementation of mitigation projects. Appendix 6-C: Assessment Report – Planning, Evaluation and Monitoring Committee (Monitoring Sheet No. 2), presents guiding questions to assess the composition and tasks of the Committee.[15]

### 6.1.1.2 Evaluation Planning Process

At this stage of the evaluation, the Planning, Evaluation and Monitoring Committee will further reflect on the planning process that was undertaken to develop the review of the PEMPN. The following questions will guide this assessment:

- What part of the planning process would be done differently according to the present reality and knowledge?
- Are there clear and well defined roles of the components of the Planning, Evaluation and Monitoring Committee?
- Are meetings held by the Planning, Evaluation and Monitoring Committee, the Interagency Committee for Mitigation and the Interagency Committee for Emergency Management productive?
- Have they followed the procedures for implementation, monitoring and evaluating the Plan?

15 Adapted from the FEMA Guidance 386-4: "*Bringing the Plan to Life: Implementing the Hazard Mitigation Plan", Appendix C.*

- Have leading agencies exercised their leadership in the implementation of projects?

The answers to these and other questions to be defined during the evaluation process will allow to establish whether changes are needed in the planning process of the PEMPN.

### 6.1.1.3 Compilation and Analysis of New Data

In this part of the evaluation, the Planning, Evaluation and Monitoring Committee continues to reflect on the processes in place to collect new data and information that have been generated by government agencies, institutions or organizations during the effective period of the 2016 PEMPN. This compilation of data includes vulnerability data generated by municipalities to develop the Municipal Mitigation Plans and those related to the structures of state critical facilities. For this task it is proposed to maintain close communication with the Puerto Rico Planning Board, since it is in the process of implementing the HAZUS project that aims to develop databases on analysis of natural hazards and potential losses in each of municipalities.

It is important that the Planning, Evaluation and Monitoring Committee compiles and analyzes studies and research findings related to natural hazards, which were not available when the 2016 PEMPN review was completed or those that will be developed during its term. For this task it is important to maintain close communication with the Puerto Rico Planning Board as this agency is

responsible, mandated by law, to maintain the official databases of the country as a Geographic Information System. Mechanisms should be established to share or make these studies available to municipalities and agencies relevant to them, according to natural hazards they are exposed to and/or mitigation projects that are being implemented. The Puerto Rico Planning Board has been appointed as the central agency to house all databases for vulnerability to natural hazards and critical facilities. The following questions will guide this assessment:

- Are the processes to operate the data collection and new information that can help evaluate and monitor the activities and mitigation projects and to update the PEMPN functioning?
- Have collected data and information relevant to agencies and/or organizations developing and implementing projects been distributed?
- Are there other more efficient methods to compile data and information and keep the database updated?

#### 6.1.1.4 Coordination with Other Agencies

This assessment component requires that the Planning, Evaluation and Monitoring Committee evaluate the elements of the coordination that takes place to monitor the agencies participation in the mitigation activities, based on how the agencies are being responsive to the meetings, progress reports and information requests, among others. The following questions will guide this assessment:

- How effective is coordination with the agencies? Is there adequate advance notice for meetings? Is there active participation from the agencies?

- Do they provide enough time to deliver progress reports?

- Do minutes, memoranda of understanding or established interagency agreements need to be revised due to changes in funding, priorities, personnel or economic/political events, among others?

### 6.1.2 Monitoring Progress of Mitigation Measures

The continuous PEMPN monitoring process will pay attention to multiple elements in order to assure their effectiveness and compliance. Therefore, in addition to monitoring the planning processes related to the PEMPN it is very important to measure the success of hazard mitigation activities outlined in the Mitigation Strategy. For this, agencies and/or entities responsible for implementing mitigation measures will be required to submit a quarterly Progress Report to the Planning, Evaluation and Monitoring Committee. These reports will be reviewed by the Committee to establish the actions to be taken. The results of the evaluation of these reports will be used to conduct the Annual Progress Report of the PEMPN and it will be part of the information to be discussed at the annual meeting to be held as part of the Consultation Program established by the Interagency Agreement between AEMEAD and FEMA.

The Planning, Evaluation and Monitoring Committee will decide the agencies and entities that will provide the Quarterly Progress Report, according to their relevance to

the PEMPN and the frequency of its submission. The delivery of these reports is essential for the Committee to carry out continuous evaluation and subsequent updating of the Plan.

The Report should contain at least the following elements:

- Mitigation goals and activities.
- Identify the lead agency and support agencies that are responsible for implementation of mitigation activities or projects.
- How long will the project or activity take to be developed and implemented, broken down by stages.
- Description of public and private resources needed to implement the project (such as: funds, human resources and technical assistance) and their status, in terms of whether they are available or if adjustments must be made to obtain them.
- List of permits and approvals necessary to implement the activity or project.
- Details of the progress of the activity or project to be conducted.

In addition to agencies, the municipalities that receive state and/or federal funds to implement its mitigation activities and projects will submit a Quarterly Progress Report to AEMEAD, which will include the same information requested to the agencies. Appendix 6-B (Monitoring Sheet No. 1) can be used as a model for agencies,

municipalities and entities responsible for the projects to submit their Quarterly Progress Report.

### 6.1.2.1 Evaluation of the Effectiveness of Mitigation Measures

To evaluate the effectiveness of mitigation measures, criteria such as programming and project planning, availability and use of the project budget and collaboration of agencies in the project development will be taken into consideration. To facilitate this task a format guide is provided in Appendix 6-D: *Evaluation of Results of the Projects (Monitoring Sheet No. 3)*. This assessment must have the following elements.

- *Evaluate the results achieved regarding the goals and objectives of the PEMPN:* This part of the assessment aims to identify whether the mitigation measures/projects have achieved the expected results and if they meet the goals and objectives of the PEMPN. The results can be unexpected for two reasons: first, because the benefits of the project or activity have surpassed expectations; and, second, the project or activity does not meet the expectations of protection and/or mitigation. Some unexpected results can be measured by their environmental, social and economic impact. Municipal mitigation projects to be evaluated cannot increase the vulnerability to natural hazards of the surrounding territory.

- *Evaluate the projects cost-effectiveness:* This part of the evaluation is intended to measure whether the project reduced the potential losses. FEMA

defines cost-effectiveness as those projects in which long-term benefits exceed their costs. To determine the cost-effectiveness of activities or projects developed more accurately a natural disaster must occur. In the absence of a natural disaster event, avoided losses due to the mitigation measures implemented can be estimated in the structural mitigation projects. Some examples of structural projects include improvements or structural strengthening protection ("retrofit"); and acquisition, demolition and relocation of vulnerable structures. FEMA has a database available for repetitive loss flood hazard which estimates the losses avoided due to the implementation of flood control projects. Regular monitoring of data allows an objective account of the losses attributed to flood events.

Soft projects refer to educational, regulatory activities and do not involve any construction or demolition. Being classified as soft does not imply that they are less effective in mitigating natural disasters. For these projects it is more difficult to assess their cost effectiveness. An example of these projects is the prohibition or restriction of development in areas classified as "Very High" or "High" vulnerability of a particular natural hazard.

If the cost-effectiveness of a mitigation project was determined through a cost-benefit analysis, the Planning, Evaluation and Monitoring Committee should review this analysis to determine if the costs and benefits were estimated or if unanticipated costs and benefits have changed. The purpose of reviewing the cost-benefit analysis is to recalculate what losses have been

reduced if the natural disaster occurred. If possible, sections of the Risk Assessment can be repeated to determine if the project reduced the potential losses. HAZUS, used to develop estimates of initial losses, can be "run" using the results of the recent disaster (applies to mitigation projects that were implemented before the occurrence of the disaster). The Puerto Rico Planning Board is in process of implementing the HAZUS system. To evaluate the effectiveness of soft projects such as educational campaigns, that have no cost-benefit analysis, other methods such as surveys are required.

- *Document activities and projects that have not been implemented or for which the implementation has been slow:* Having identified the actions that were implemented, those that were not, and their results, the Planning, Evaluation and Monitoring Committee must document the reasons why the project is implemented or not performed. It is important to discuss why some of the activities and mitigation projects have not met the established implementation schedule, have not been completed or never started. Some projects should be modified or removed from the list of priorities if they encountered problems that cannot be remedied. An example of this is those projects that rely on voluntary relocation either residential or commercial.

  If the mitigation activity or project was not successful it is important to identify the actions that will be developed to modify or replace this project. If a project was partially implemented, there is a need to research and

document the reasons why it was not completed (i.e., exceeded the budget). The government's fiscal situation may be one of the pertinent reasons.

Understanding the factors that contribute to the success of a project, activity, program or policy is particularly important in order to replicate it. At the time of the evaluation the following aspects should be examined:

- The availability of human, technical and financial resources, among others.
- The support or opposition to public policy or mitigation action.
- The priority of the project within the other responsibilities and work program of the agency or its designee.
- The time currently available and necessary to implement the actions.

Appendix 6-D: Evaluation of Project Results may be useful in completing this task.

### 6.1.3 Evaluation of the Implementation of Municipal Mitigation Plans

The development and implementation of Municipal Mitigation Plans is a fundamental part of the process of monitoring and evaluating the implementation of the PEMPN. Unlike the 2011 PEMPN, this activity will be centralized in the Office of the GAR in coordination with the AEMEAD Mitigation Division. Evaluation activities of both offices should be based on the analysis and findings of the Plans. This information should

be part of Chapter: Local Mitigation and Coordination Capacity in its next revision. This section of the PEMPN provides an integrated analysis of all municipal mitigation plans approved to date for the review. The area of analysis categorizes the following fundamental issues:

- Goals and objectives set out in the Municipal Mitigation Plans
- Hazards identified by each municipality
- Potential losses listed by hazards, and identified by each municipality
- Mitigation projects and activities proposed by each municipality
- Priority of each municipality to meet needs identified

The GAR will be responsible for monitoring the implementation of mitigation activities and allocation of resources to municipalities, taking into account the following elements:

- Relationship between municipal mitigation activities or projects and the goals, objectives and mitigation strategies of the PEMPN.
- Status of activities or projects under development.
- Provision of effective technical assistance and training.
- Review of priorities assigned to the municipalities according to changes in resources or disaster events.

- Schedule for reviewing and updating municipal plans (five-year periods are met at different times).
- Changes in local government due to political changes or budgetary situations.

### 6.1.4 Impact Assessment of a New Natural Disaster

After a natural disaster, municipal and state governments feel public pressure to rebuild as soon as possible. Typically, communities wish for a fast and similar reconstruction as before the disaster. The municipal and state governments, as well as communities, have to be balanced in the analysis and decision making for the best reconstruction process, as it is important that the community or infrastructure rebuilt is resistant to natural disasters. In the event of a natural disaster, the timing of mitigation activities and projects will likely be affected. The tasks of the Planning, Evaluation and Monitoring Committee in case of a new disaster shall be as recommended below.

#### 6.1.4.1 Re-evaluate Priority List of Hazard Mitigation and Mitigation Projects

Upon the occurrence of a natural disaster the Planning, Evaluation and Monitoring Committee will meet and evaluate the Priority List of Natural Hazards Mitigation which is part of Chapter 2: Hazard Assessment ("Risk Assessment"). The Committee will assign high priority to identify potential mitigation projects in a post-disaster scenario. This task of re-evaluation of the list depends on the severity of the recent disaster. It is important to verify whether this natural hazard which has struck so severely was in high or low priority.

### 6.1.4.2 Re-evaluate Vulnerability Analysis

Hazard Assessment, Chapter 2, makes an analysis and estimate of the type and intensity of the damages that can cause natural hazards. The Planning, Evaluation and Monitoring Committee will evaluate whether the information provided in the Plan was consistent with the occurrence of the most recent natural hazard event. It may be necessary to collect additional data related to the event and incorporate this information to the analysis of vulnerability. Appendix 6-E: Monitoring and Evaluation of Natural Hazards (Monitoring Sheet No. 4) shows the basic areas that should be considered in reviewing the inventory of natural hazards.

### 6.1.4.3 Evaluate the Effectiveness of Projects Implemented

The occurrence of a disaster is the best opportunity to evaluate the performance of implemented mitigation projects. The Planning, Evaluation and Monitoring Committee should collect data related to natural disaster to eventually incorporate it into the updated PEMPN. It is recommended to create tables to gather information about: estimates of losses avoided by the danger in comparison with previous disaster and damages to agriculture and infrastructure, among other variables. This information will allow comparison of the costs incurred to address a disaster before implementing mitigation projects and costs incurred to address the disaster after the implementation of mitigation projects and activities. Here is an example of a table that can be prepared to collect post-disaster information.

***Table 6.1***
***Losses Linked to a Natural Disaster***

| Variables | 2014 | 2018 | % Change |
|---|---|---|---|
| Number of families evacuated and accommodated in shelters | | | |
| Number of families receiving assistance from the Department of Family | | | |
| Number of families receiving assistance from the Red Cross | | | |
| Money awarded by FEMA for housing assistance | | | |
| Other variables | | | |

The evaluation will include cost-benefit analysis of the activities implemented. This analysis can quantitatively demonstrate the effectiveness of mitigation activities and determine which actions are most effective. This process will take place after the disaster damage information is collected and quantified by AEMEAD, FEMA, municipalities and additional agencies related or affected by the disaster. The evaluation will be a joint effort that would involve the Planning Board and universities or organizations as technical advisers for data analysis.

### 6.1.5 Keeping the Public Informed and Involved

It is important that the Planning, Evaluation and Monitoring Committee keeps the public informed of progress and achievement of the projects, in particular interested stakeholders such as professional associations and municipalities impacted by the mitigation projects and activities. This task contributes to

increase the inclusion and commitment of citizens with the implementation of the Plan. For this, media such as municipal, regional and national, newspapers, and news by radio and television, among others, will be used as necessary; AEMEAD will post on its website a copy of the PEMPN, the mitigation activities or projects underway and include information about changes made to PEMPN o the projects, and announcement of processes, as well as the opportunity for citizens to comment or answer questions.

## 6.2 Methodology and Planning of the Review and Update of PEMPN

Planning is an ongoing process and the PEMPN must be treated as a "living" document that has to grow, change and adapt to changes that Puerto Rico confronts, as are the socioeconomic particularities of the present historic moment. Accordingly, the "Disaster Mitigation Act 2000" requires the State Plan be updated every five (5) years. That is, unless a disaster event occurs before this period. The assessments in the sections described above are used as input to update the PEMPN. Appendix 6-F: Plan Review Guide for the Puerto Rico Natural Hazard Mitigation Plan (Monitoring Sheet No. 5) shows a general scheme to guide the review and update of the Plan.

### 6.2.1 Revise Factors Affecting the PEMPN Planning Context

The planning context can be affected by the state's capacity to implement mitigation projects and broader vulnerability analysis. This implies the need to review and evaluate the sections on Hazard Assessment and Evaluation of State Mitigation Capacity of the PEMPN in order to adjust to the new reality. This element is of particular importance to

the current revision of the 2016 PEMPN due to the fiscal situation of the country and to changes in sociodemographic characteristics. Some aspects that will help determine what changes to the Plan are required to be updated are presented below.

#### 6.2.1.1 Review the Natural Hazard Assessment

The review of natural hazard assessment will be conducted to update the estimates of potential losses, new scientific data for areas vulnerable to hazards, the effects of hazards in the municipalities and critical facilities, changes in patterns of population and urban growth, and the reduction in vulnerability due to the mitigation projects implemented. In addition, the findings of natural hazard assessments conducted by the municipalities that have updated their Municipal Mitigation Plans during the term of PEMPN should be integrated.

The future upgrade of the sections on hazard evaluation of the PEMPN must include an analysis of hazards that were not covered by inventories and hazard assessments that were made earlier. Another important element is to incorporate the effects that the phenomenon of global climate change has had and may have on the Island.

It is recommended that for the Assessment of State Natural Hazards, the following change variables be evaluated, among others:

- *Changes in the Patterns of Development*: The Planning, Evaluation and Monitoring Committee will determine whether changes have occurred in patterns of population and urban growth. These types of changes can

influence the effects of natural hazards and create additional risks set forth in the PEMPN.

- *Changes Generated by the Effects of Climate Change*: To assess the effects of this global phenomenon with regard to the incidence of natural hazards, particularly on vulnerable municipalities such as the coastal area of the Island.

- *Areas Affected by Recent Disasters*: The recent disaster events can provide new information about the ways a community can be affected. The Committee should compare the effects of a new disaster event with the available information on events that occurred previously.

- *New Studies or Technologies Available*: Consider new studies on aspects that can affect vulnerability analysis of risks. Examples of some studies are: demographic, hydrological, and geological and traffic, among others. In addition, consider studies on new techniques, technologies and methods of mitigation.

- *Re-estimating Losses*: The new information available can help to recalculate the losses or review the cost-benefit analysis of the mitigation projects or activities.

### 6.2.1.2. Review State Capability Assessment

It is necessary to review and evaluate changes to the information contained in the chapter devoted to State Mitigation Capacity to determine changes in the laws, agencies and the availability of human, financial and technical resources that can affect the PEMPN. Some aspects to consider should be:

- *Changes in State and/or Federal Laws, Policies, Plans and Funds*: The regulations relating to land use and the environment may have been strengthened or loosened. This will represent for the country further constraints or opportunities for mitigation. The same occurs with the availability of local and federal funds.

- *State Fiscal Situation*: Affordability (financing capacity) of the agencies concerned with the mitigation activities or projects and emergency management, taking into account the limitations imposed by the State to address the economic downturn or recession.

- *State Socioeconomic Changes*: The significant social changes may influence mitigation priorities and the implementation of projects. Examples of socio-economic changes are the economic recessions, increased cost of living, changes in political climate, demographic changes and environmental justice issues, among others. In addition, changes in migration patterns and their effects on land use and other socioeconomic elements.

- *Other changes*: Changes identified and that could positively or negatively affect the initiatives for natural hazard mitigation.

### 6.2.2 Analyze the Findings and Determine if the Planning Process and/or Mitigation Strategy must be Reviewed

The Planning, Evaluation and Monitoring Committee will use the new knowledge gained to identify areas of the PEMPN or the planning process that need to be modified. It will pay special attention to the significant changes in the availability of resources, vulnerability to the hazards identified, and the goals and priorities of the PEMPN.

It is important to consider updating the goals, objectives and actions that are proposed in the Plan. The Planning, Evaluation and Monitoring Committee must integrate what they learn in the process of government administration and evaluation of the interests of the community about the objectives of the PEMPN. These elements must be considered when the strategies of the Plan are re-evaluated. Using monitoring systems described in the previous sections, the Committee will discuss future actions that will be necessary to undertake, reconsider or eliminate from the PEMPN. The following elements are suggested to guide the discussion:

- Check whether the goals and objectives are applicable or are obsolete according to the changes that have occurred in society.
- Check whether the Plan's priorities match the priorities of the State and the communities.
- Check for mitigation projects that need to be re-prioritized for implementation.
- Check if the mitigation projects can be developed with available resources.

### 6.2.3 Incorporate the Findings to PEMPN

Upon completion of the processes described in this chapter, the Planning, Evaluation and Monitoring Committee will have the tools necessary to carry out the updating of the PEMPN. The updated Plan should include the latest findings on Municipal Mitigation Plans, inventory of natural hazards and their vulnerability, as well as the results of the activities and projects listed in the Plan for the previous period.

It is necessary to update the description of the planning process to add the actions taken by PEMPN in the process of evaluating and updating the Plan. In addition, the mitigation strategy must be updated taking into consideration the activities or projects conducted, in process or not conducted and incorporate new projects identified as necessary. The strategy review should also consider the availability of funds to finance activities or projects, technical and human resources and development time, among other elements of the implementation strategy.

The updated Plan must be reviewed by the government and community sectors interested in it so that it is valid. This is completed based on meetings, presentations and opportunities to provide comment to the Plan. After that the formal adoption process of the PEMPN is follow as required by state and federal laws.

## 6.3 Evaluation of Effectiveness and Programming Methodology of the PEMPN

As described in Chapter 1, the evaluation process developed for the 2011 PEMPN was established so it could be completed at various levels. First, we conducted a comprehensive

review of the document. This comprehensive review aimed to perform a total reading and analysis of the PEMPN to establish a general consensus on the level and magnitude of changes that would be needed to update the Plan. After completing this evaluation, the activities to upgrade the different chapters of the 2016 PEMPN were identified. The evaluation determined which sections of the Plan would require more effort and which could be preserved with less significant changes.

A second approach was to make judgments on the goals, objectives and mitigation activities that were proposed in the 2011 PEMPN. All of these proposals are possibly the most fundamental part of this planning document. The results of the evaluation offer valuable information regarding the development and implementation of the goals, objectives and mitigation activities, and help to determine the actions to follow in order to foster a more effective implementation during the effective period of the 2016 PEMPN.

The third assessment approach was to use the input provided by all direct and indirect participants in developing the Plan during the period of consultation and discussion. That is, not only those who provided the various working committees, but also the result of data and information supplied by the various state and federal government agencies and contributions, comments and information obtained as part of public discussion by professionals, interest groups and private citizens. Recommendations and changes that emerged from this evaluation approach were incorporated during the process of revising the document.

## 6.4 Certification of Compliance with Law Statutes

Drafting and revising the State Natural Hazard Mitigation Plan has been completed following the requirements set by the federal law "Disaster Mitigation Act of 2000 (PL 106-390)" and specifications defined in the "Multi-Hazard Mitigation Planning Guidance Under the Disaster Mitigation Act of 2000 (Blue Book)" and the "State Mitigation Plan Review Guide" (FP 302-094-2) effective March 6, 2016.

As part of the Plan implementation, the State recognizes and certifies full compliance with federal statutes and regulations applicable to receive funding grants as described in 44 CFR 13.11(c). Furthermore, in compliance with the requirements in 44 CFR 13.11(d), the Commonwealth certifies that the PEMPN will be amended in case of the establishment of new regulations or federal statutes, changes in applicable state laws and significant changes in the organization, public policy or operation of the Puerto Rico Emergency Management Agency (AEMEAD), in charge of implementing the PEMPN. Any amendments made during the period of validity of the PEMPN will be added as an attachment to the original plan and later be incorporated into the appropriate sections when conducting the next formal review of the Plan.

# REFERENCES


Agencia Estatal para el Manejo de Emergencias y Administración de Desastres, *Plan Estatal de Mitigación de peligros Naturales de Puerto Rico*, 2011.

Agencia Estatal para el Manejo de Emergencias y Administración de Desastres, *Plan Operacional de Emergencias de la Represa de Patillas*, Febrero, 2016.

Agencia Estatal para el Manejo de Emergencias y Administración de Desastres, *Presentación: Plan de Continuidad de Operaciones del Negocio ante Desastres*.

Agencia Estatal para el Manejo de Emergencias y Administración de Desastres, *Plan de Adaptación al Cambio Climático*.

Centro de Coordinación para la Prevención de los Desastres Naturales en América Central, Dr. Juan Carlos Villagrán De León, *Sistemas de Alerta Temprana para Emergencias de Inundaciones en Centroamérica.*

Consejo de Cambio Climático de Puerto Rico, *Presentación: ¿Incendios Forestales en Puerto Rico: Naturales o Antropogénicos?*, 3 de octubre de 2014.

Consejo de Cambio Climático de Puerto Rico, *El Estado del Clima de Puerto Rico; Estrategias de Adaptación y Prevención de Riesgos Costeros,* 2014.

Consejo de Cambio Climático de Puerto Rico, *Evaluación de la Vulnerabilidad Socio-Ecológica de Puerto Rico en un Clima Cambiante,* 2014.

Consejo de Cambio Climático de Puerto Rico, *Estado del Clima de Puerto Rico 2010-2013.*

Departamento de Recursos Naturales y Ambientales-Programa de Manejo de la Zona Costanera, *Estrategias de Control de Erosión e Inundaciones Costeras,* 2015.

Estado Libre Asociado de Puerto Rico-Junta de Planificación, *Programa de Inversiones de Cuatro Años (PICA),* Años Fiscales 2014 - 2015 a 2017 – 2018, Agosto, 2014.

Estado Libre Asociado de Puerto Rico-Junta de Planificación, *Plan de Uso de Terrenos*, 19 de noviembre de 2015.

Estado Libre Asociado de Puerto Rico-Junta de Planificación, *Reglamento Conjunto para la Evaluación y Expedición de Permisos Relacionados al Desarrollo y Uso de Terrenos*, 24 de marzo de 2015.

Estado Libre Asociado de Puerto Rico-Junta de Planificación, *Reglamento de Lotificación y Urbanización*, 27 de enero de 2016.

Estado Libre Asociado de Puerto Rico-Junta de Planificación, *Reglamento sobre Áreas Especiales de Riesgo a Inundación*, 7 de enero de 2010.

Federal Emergency Management Agency (FEMA), *Climate Change Adaptation Policy Statement*, 2011-OPPA-01, 2011.

FEMA, *Hurricane Irene*, FEMA-4017-DR, August 27, 2011.

FEMA, *Severe Storms, Flooding, Mudslides, and Landslides*, FEMA-4004-DR, July 14, 2011.

FEMA, *State Mitigation Plan Review Guide,* FP302-094-2, March, 2016.

FEMA, *Tropical Storm María,* FEMA-4040-DR, October 18, 2011.

Junta de Planificación-Sistemas de Información, *Presentación: Hazus MH-Puerto Rico*.

Ley Núm. 80 de agosto de 1991: *Ley del Centro de Recaudación de Ingresos Municipales* o Ley Núm. 80 del 30 de Agosto de 1991.

Ley Núm. 81 de agosto de 1991: *Ley de Municipios Autónomos* o Ley Núm. 81 del 30 de agosto de 1991.

Ley Núm. 82 de agosto de 1991: *Ley para Enmendar la Ley de Patentes Municipales* o Ley Núm. 82 del 30 de agosto de 1991.

Ley Núm. 83 de agosto 1991: *Ley de Contribuciones sobre la Propiedad Municipal* o Ley Núm. 83 del30 de agosto de 1991.

Ley Núm. 213 de Puerto Rico *Ley Núm. 213* del 12 de mayo de 1942, para crear la Junta de Planificación, Urbanización y Zonificación de Puerto Rico.

Ley Núm. 75 *Ley Orgánica de la Junta de Planificación* de 1975 para crear la Junta de Planificación de Puerto Rico (JPPR) y la Administración de Reglamentos y Permisos (ARPE), 1975.

Naciones Unidas, *Convención Marco sobre el Cambio Climático-Acuerdo de Paris*, 12 de diciembre de 2015.

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# Puerto Rico 2016 THIRA

## THIRA Steps 1-2: Threats & Hazards

### Hurricane / Typhoon

**Category:** Natural **Type:** Hurricane / Typhoon **Terrorism:** No

**Context Description:**

During a hurricane season with ocean temperatures higher than normal, due to the effects of climate change, the first week of September a Category 4 hurricane with sustained winds of 140mph is making landfall in the municipality of Humacao in the east coast of Puerto Rico at 02:00 a.m. It is moving westward at a speed of 12mph. The hurricane is causing catastrophic effects on the ground for 8 straight hours in the whole island as it cross and left the island thru the northwest coast (Municipality of Aguadilla). On higher grounds, gusts exceed 162 mph winds (Cat 5 hurricane).

### Cyber Attack

**Category:** Human Caused **Type:** Cyber Attack **Terrorism:** Yes

**Context Description:**

It's the last day of the month of September, during the peak of the Hurricane Season. Most of Puerto Ricans got paid from their jobs. Although people have checked their bank account balances in the internet, people are not able to process their credit and debit cards at any store or get cash from the ATM machines. Balances in all accounts are zero ($0). People rush to the banks to get an explanation and ask for their money. Banks are becoming a hostile environment and Police is call to action. A chaos is being generated; people are stuck in gas stations and stores, unable to buy food for their homes and families. Riots and protests are being held against all banks and institutions. Government cannot explain what has happened and are trying to figure out how this occurred.

### Earthquake

**Category:** Natural **Type:** Earthquake **Terrorism:** No

**Context Description:**

At 10:00 a.m., during a regular work week of mid-August, a strong tremor is felt in the Metropolitan Area of San Juan and surrounding areas for 32 seconds. A 7.0 magnitude earthquake in the Richter Scale was registered with a depth of 10 KM. A Tsunami Warning is in effect as a preventive measure due to the magnitude of the earthquake. August has experienced many numbers of days with extremely high temperatures due to climate change, which has caused more stress on infrastructures than simply an increase in the average temperature. Many bridges, government and commercial buildings and high rises housing condominiums located in high population areas are severely affected. There are thousands of injured people and the magnitude of death toll cannot be determined during the first 12 hours.

## Flood

**Category:** Natural **Type:** Flood **Terrorism:** No

**Context Description:**

During the month of May a stationary low-pressure system has been affecting most of the island of Puerto Rico for three consecutive days. The soil had been saturated due to the increase in frequency and intensity of regional downpours due to climate change particularly downpour events in May. In some places 4 inches per hour precipitation is registered. The most affected areas are municipalities located in the center of the island (Lares, Adjuntas, Utuado, Jayuya, Ciales, Orocovis, Morovis, Corozal, Naranjito, Barranquitas and Comerio). Coastal areas, which hold 63% of the population of the island, are flooded due to the overflow of the central region watersheds and main rivers. Main roads and rural bridges are flooded or compromised.

## Tsunami

**Category:** Natural **Type:** Tsunami **Terrorism:** No

**Context Description:**

At 03:00 a.m. during the peak season of tourist activity in the island, an 8.5 magnitude earthquake in the Richter Scale occurred 40 KM offshore of San Juan with a depth of 10KM causing a tsunami with waves up to 9.75 meters (32 feet) in height. The tsunami has caused severe impact and flooding in low areas of high coastal population, dense housing and in finance and business centers in the San Juan Area. Rising sea level due to climate change in the north coast of Puerto Rico especially in San Juan and surrounding municipalities (Carolina, Loza, Guaynabo, Catao, Toa Baja) have amplified the effects of the tsunami. Severe floods have affected critical transportation areas (airports, seaports, roadway systems) and infrastructure systems (electric power plants, sanitary systems, waste water treatment plants, industrial parks) located near the coast.

# THIRA Step 3: Establish Capability Targets and Impacts & Desired Outcomes

**Puerto Rico**

## Planning

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|---|---|
| **Capability Target:** | Prevention: Maintain 100% of state and local all-hazard Emergency Operations Plans that address all five mission areas (prevent, protect, mitigate, respond and recovery) with specific annexes as required. The plans identify critical objectives and provide the sequence and scope of tasks required to achieve the objectives. The plans are vertically and horizontally integrated with appropriate departments, agencies, and jurisdictions. The plans are reviewed every 2 years. Emergency Operations plans are implemented within reasonable timeframes when prior notice of an emergency event is confirmed or as soon as possible for unanticipated incidents. Mitigation: Develop, implement, evaluate and/or revise the jurisdiction's Hazard Mitigation Plan every 5 years. Support the development, implementation, evaluation and revision of All-Hazards Mitigation Plans for 78 local jurisdictions every 5 years. Protection: Three months before hurricane season, PREMA plans and assess operational zones and 78 municipalities for Emergency Operational Plan status and readiness for activation. Response: Maintain 100% of state and local all-hazard Emergency Operations Plans that address all five mission areas (prevent, protect, mitigate, respond and recovery) with specific annexes as required. The plans identify critical objectives and provide the sequence and scope of tasks required to achieve the objectives. The plans are vertically and horizontally integrated with appropriate departments, agencies, and jurisdictions. The plans are reviewed every 2 years. Emergency Operations Plans are implemented within reasonable timeframes when prior notice of an emergency event is confirmed or as soon as possible for unanticipated incidents. Recovery: Within 24 hours, convene the core of an inclusive planning team (identified pre-disaster) which will oversee disaster recovery |

planning. Within 30 days, develop a recovery strategy that provides and overall strategy and timeline, addresses all core capabilities, and integrates socioeconomic, demographic, accessibility, community outreach, and risk assessment considerations, which will be implemented in accordance with the timeline contained in the plan.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | 500 Shelters verified ready for activation in case needed. Emergency Operational Plans of the State, 78 municipalities and PREMA zones need to be updated and ready for activation. | 3 months before hurricane season PREMA plans and assess operational zones and 78 municipalities for Emergency Operational Plan status and readiness for activation. |
| Earthquake | Activation of COOP Plan and the establishment of an alternate EOC. 500 Shelters verified ready for activation in case needed. Emergency Operational Plans of the State, 78 municipalities and PREMA zones need to be updated and ready for activation. | Emergency Operational Municipal and State Plans reviewed and ready to be activated simultaneously with the state emergency agency. |
| Flood | Activation of COOP Plan and the establishment of an alternate EOC. 500 Shelters verified ready for activation in case needed. Emergency Operational Plans of the State, 78 municipalities and PREMA zones need to be updated and revised. | Emergency Operational Municipal and State Plans reviewed and ready to be activated simultaneously with the state emergency agency. |

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| Tsunami | 500 Shelters verified ready for activation in case needed. Emergency Operational Plans of the State, 78 municipalities and PREMA zones need to be updated and ready to be activated. | Emergency Operational Municipal and State Plans reviewed and ready to be activated simultaneously with the state emergency agency. |
| Cyber Attack | Emergency Operational Plans of the State, 78 municipalities and PREMA zones need to be updated and ready to be activated. | Emergency Operational Municipal and State Plans reviewed and ready to be activated simultaneously with the state emergency agency, if necessary. |

## Public Information and Warning

**Capability Target:** Prevention: Within 2 months, develop and implement a public awareness campaign to inform 3.5M people within the state of methods to identify and report suspicious activity to law enforcement entities through initiatives such as the DHS "See Something, Say Something Campaign or other similar program(s).Protection: Three minutes after the incident occurs, a news release is published thru radio, social media, press and television to provide information and public awareness to 100% of the population. In case of power outages, the news will be delivered by phone. Mitigation: Every year, conduct 2 public information and warning campaigns to provide 3.1M people within the jurisdiction with useful and relevant information on the threats and hazards faced by the community and how to prepare for them. Response: Three minutes after the incident occurs, a news release is published thru radio, social media, press and television to provide information and public awareness to 100% of the population. In case of power outages, the news will be delivered by phone. Recovery: Within 3 months after the incident occurs, a news release is published thru radio, social media, press

and television or another mass notification system with deliver credible, recovery-based, accessible messages in order to facilitate the transition from response to recovery, and to inform the public of all available recovery funds and resources in coordination with all ESF-14 partners, across all sectors.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
| --- | --- | --- |
| Hurricane / Typhoon | Provide information and public awareness to the 100% of the population. | All Public Information Systems are established and monitored during the first 12 hours of the tropical storm warning notification from the National Weather Service |
| Earthquake | Provide information and public awareness to the 100% of the population. | 3 minutes after the incident occurs, a news release is published thru radio, social media, press and television to inform the situation and precautions. In case of power outages, the news will be delivered by phone. |
| Flood | Provide information and public awareness to the 100% of the population. | Immediately after the Emergency Alert System will be activated to announce possible floodable areas by the Weather Service, a news release will be published for public awareness and precautions. |
| Tsunami | Provide information and public awareness to the 100% of the population. | 3 minutes after the incident occurs, the Emergency Alert Systems is activated and a news release is published thru radio, social media, press and television to inform the public and precautions to take. In the case of power outages, the news will be delivered by phone. |

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| Cyber Attack | Provide information and public awareness to the 100% of the population. | Within two hours of receiving the Police Department report, PREMA will make a news release through social media, press and television to inform the public of the situation. |

## Operational Coordination

**Capability Target:** Prevention: Within 2 hours of receipt of information about a credible threat of imminent attack, establish operations with functional and integrated communications between the Incident Command Structure, State Information and Analysis Center, State EOCs, 78 Local EOCs and other stakeholder Multi-Agency Coordination groups at the Federal, state and local levels to coordinate investigation, intelligence gathering, and other prevention activities at all levels. Protection: Establish and maintain a unified and coordinated multi-agency operational structure and process five 5 days prior to an anticipated incident or within two hours after an incident has begun or concluded, that integrates 100% of critical stakeholders and support the execution of core capabilities. Mitigation: 12 weeks prior to a National Special Security Event, Fusion Center will develop and disseminate a special event threat assessment to relevant stakeholders in an attempt to provide situational awareness that could assist in disrupting or deterring a potential terrorist attack. Response: Immediately after the incident, all emergency management personnel become activated and must report to the Emergency Operation Center (EOC) for the establishment of command, control and coordination structures. In 4-5 hours after the incident occurs, priority missions such as search and rescue, fire extinction and the establishment of shelters begin. In 24 hours, the state EOC becomes fully activated with 50 government agencies, 15 ESF's, FEMA, 78 municipalities, Red Cross, Salvation Army and voluntary groups (VOAD's) to meet human needs and stabilize the incident until recovery

activities are finalize. If the current state EOC is inoperable, an alternate EOC will be activated. Recovery: Within 30 days of the opening of the Joint Field Office (JFO) in each jurisdiction, define the path and timeline for recovery leadership to achieve the jurisdiction's objectives and effectively coordinate and use appropriate assistance from 10 Federal, 30 states, and 78 local entities, as well as nongovernmental and private sector resources.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Daily meetings with the Weather Service and National Hurricane Center (48 hours before the hurricane hits). All operational plans of every government agency need to be revised and protection measures need to be implemented. Every 4 hours development of situational reports needs to be performed. | 72 hours before the hurricane hits the island, the Emergency Operation Center becomes fully activated as well as 50 government agencies and the 15 ESF's. In 48 hours before the hurricane hits, coordination of the response is fully activated between the government agencies, FEMA, 78 municipalities, Red Cross, Salvation Army and voluntary groups (VOAD's) until recovery activities are finalized. |
| Earthquake | A great number of emergency management staff will be unavailable to report to the EOC due to deaths or injuries of them and family members and wide-spread disruptions in infrastructure and roadways which will impede operational coordination. | Immediately after the incident, all emergency management personnel become activated and must report to the Emergency Operation Center for the establishment of command, control and coordination structures. In 4-5 hours search and rescue activities begin as well as fire extinction and coordination for the establishment of shelters. In 24, the |

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| | Emergency priorities will need to be established as well as preliminary damage assessments to the state EOC to determine its safety. Coordination for aerial assessments of mayor damaged areas need to be performed. | central EOC becomes fully activated with 50 government agencies, FEMA, 78 municipalities, Red Cross, Salvation Army and voluntary groups (VOAD's) until recovery activities are finalized. In case the central EOC is inoperable, an alternate EOC will be activated. |
| Flood | Coordination for search and rescue missions, activation of the necessary shelters for people that live in floodable areas and establishment of priorities according the situational analysis. Coordination for the mobilization of public works machinery for debris removal. | In 2 hours, the state EOC will partially activate along with the primary response and infrastructure government agencies until all recovery missions are done. |
| Tsunami | Operational coordination and command for the evacuation and mobilization of 250,000 persons that live in tsunami prone areas in the island and communities in identified vulnerable areas need to be performed. Some emergency management staff will be unavailable to report to duty due to | Immediately after the earthquake is reported and Tsunami warning is in effect all emergency management staff become activated and must report to the Emergency Operation Center for the establishment of command, control and coordination structures. In 4-5 hours after the incident, priority missions such as search and rescue begin as well as the coordination for the |

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| | deaths or injuries and wide-spread disruptions in infrastructure and roadways which will impede operational coordination. Emergency priorities will need to be established along with the coordination of aerial assessments of mayor damaged areas. | establishment of shelters. In 24 hours, state EOC becomes fully activated as well as the 12 local EOC's, 50 government agencies, FEMA, 78 municipalities, Red Cross, Salvation Army and voluntary groups (VOAD's) until recovery activities are finished. |
| Cyber Attack | Coordination for the establishment of law enforcement support with the Puerto Rico Police Department, Department of Natural Resources Ranger staff, Municipal Police and National Guard. | In 2 to 3 hours after the incident starts, activate partially the EOC along with law enforcement and primary state agencies to assure the basic services are available to the population until the emergency finishes. |

## Forensics and Attribution

**Capability Target:** Within 24 hours in coordination with state and federal law enforcement agencies, activate emergency technology equipment for conducting digital media and network exploitation and forensic investigation for determination of the nature and scope of the attack, and fuse intelligence, law enforcement information and technical forensic conclusion to develop attribution assessments.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |
| Earthquake | N/A | N/A |

| | | |
|---|---|---|
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | Activation of emergency technology equipment for conducting digital media and network exploitation and forensic investigation for determination of the nature and scope of the attack. Fuse intelligence, law enforcement information and technical forensic conclusions to develop attribution assessments. | Within 24 hours, in coordination with state and federal law enforcement agencies, conduct forensic analysis of scene and evidence compilation. |

## Intelligence and Information Sharing

**Capability Target:** Within 1-3 hours of receiving actionable intelligence or information, PR Fusion Center elaborates and disseminates a Situational Awareness report and Awareness Notes (updates to the situation) to state and local law enforcement agencies, federal partners and local Bank Security Committees.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |
| Earthquake | N/A | N/A |

| | | |
|---|---|---|
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | Participation on regular advisories by MS ISAC (Multi State Information Sharing and Analysis Center) for possible cyber threats. Develop public awareness educational campaigns on current and active threats (Stop/Think/Connect). Implementation of SARS Program campaigns and monthly meetings. | Fusion Center, law enforcement agencies and federal partners continually collaborate in the identification of cyber threats by operating within the intelligence cycle. Within 1-3 hours of receiving actionable intelligence or information, PR Fusion Center elaborates and disseminates a Situational Awareness report and Awareness Notes (updates to the situation) to state and local law enforcement agencies, federal partners and local Bank Security Committees. |

## Interdiction and Disruption

**Capability Target:** Prevention: Establish a Security Operational Center (SOC) that operates 24 hours 7 days of the week, to monitor and prevent possible threats, private sector should implement aggressive policies and practical guides for information systems and response on threats. Protection: Implement Identify, Protect Detect, Respond and Recover Protocol, create a State Computer Security Incident Response Team and legislation that forces private and state entities to share information on threats and report incidents made to the information systems to the Police Department.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |
| Earthquake | N/A | N/A |
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | Prevention: Private sector should design and implement aggressive policies and practical guides for the use of information systems and threat response. Protection: Create a State Computer Security Incident Response Team and legislation that forces private and state entities to share information on threats and report incidents made to the information systems to the Police Department. | Prevention: Establish a Security Operational Center (SOC) that operates 24 hours 7 days of the week, to monitor possible threats. Protection: Implement Identify, Protect, Detect, Respond and Recover Protocol". |

## Screening, Search, and Detection

**Capability Target:** Continually screen and monitor suspicious groups and persons with high potential for criminal cyber acts, maintain a statistical base and reports of criminal groups and persons, identify hacker operational modes and possible future motivations and achieve collaborative

agreements with government agencies and private sector for reporting threats and criminal acts to PR Police Department and Fusion Center.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |
| Earthquake | N/A | N/A |
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | Maintain a statistical base and reports of criminal groups and persons. Identify hacker operational modes and possible future motivations. Achieve collaborative agreements with government agencies and private sector for reporting threats and criminal acts to PR Police Department and Fusion Center. | Continually screen and monitor suspicious groups and persons with high potential for criminal cyber acts. |

## Access Control and Identity Verification

**Capability Target:** Maintain a system of authentication to ensure identity verification and authorize access or immediately block if a threat is identified by implementing different credential

revision options like 3 way/factor authentication /authorization system, 8 digit /complex passwords, and credential verification for network access and withdrawal.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |
| Earthquake | N/A | N/A |
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | Implement different credential revision options: 3 way/factor authentication and authorization system, 8 digit and complex passwords, and credential verification for network access and withdrawal. | Maintain a system of authentication to ensure identity verification and authorize access or immediately block if a threat is identified |

## Cybersecurity

**Capability Target:** Protect and maintain cyber access control measures of networks and systems in 100% of bank and financial institutions in Puerto Rico.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |
| Earthquake | N/A | N/A |
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | 100% bank and financial networks and systems protection. | Protect and maintain cyber access control measures of networks and systems in bank and financial institutions in Puerto Rico. |

## Physical Protective Measures

**Capability Target:** Implement and maintain physical security measures, policies and procedures and adoption of particular/individual identity verification methods like magnetic cards, voice, fingerprints or handwritings to control access to networks, systems and other bank and financial infrastructures.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |

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|---|---|---|
| Earthquake | N/A | N/A |
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | Adoption of particular/individual identity verification methods like magnetic access cards, voice, fingerprints or handwritings to control access to networks, systems and bank infrastructures. Increase control of physical access to bank facilities by conducting perimeter revisions and patrol to detect any suspicious activity. | Implement and maintain physical security measures, policies and procedures in all bank and financial institutions. |

## Risk Management for Protection Programs and Activities

**Capability Target:** Complete, review and update risk assessments on 100% of banks, financial institutions and other critical infrastructure that can be affected by a cyberattack of this kind to identify protective measures.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | N/A | N/A |

| | | |
|---|---|---|
| Earthquake | N/A | N/A |
| Flood | N/A | N/A |
| Tsunami | N/A | N/A |
| Cyber Attack | 100% bank, financial and critical infrastructure completes a risk assessment for this kind of threat. | Complete, review and update risk assessments on bank, financial institutions and other critical infrastructure that can be affected by a cyberattack of this kind to identify protective measures. |

## Supply Chain Integrity and Security

**Capability Target:** Daily assess and maintain the continuous operation and security/resilience of 8 ports across the whole island and of 6 critical transit routes. After an incident, within 12-24 hours, conduct port inspections and certification for reopening and operation.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Daily revision of ports (including airports) and pier infrastructure, and navigation buoys. Annual Coast Guard security inspection compliance. Response: Closure of San Juan Bay Area Port (Alternative Port: Ponce) | Daily maintain the continuous operation and security / resilience of 8 ports across the whole island and of 6 critical transit routes. Response: Within 12-24 hours, conduct port inspections and certification for operation. |

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| Earthquake | Daily revision of ports (including airports) and pier infrastructure, and navigation buoys. Annual Coast Guard security inspection compliance. Response: Closure of San Juan Bay Area Port (Alternative Ports: Ponce, Mayaguez and Ceiba). Alternative Airport: Aguadilla | Daily maintain the continuous operation and security / resilience of 8 ports across the whole island and of 6 critical transit routes. Response: Within 12-24 hours, conduct port inspections and certification for operation. |
| Flood | Daily revision of ports (including airports) and pier infrastructure, and navigation buoys. Annual Coast Guard security inspection compliance. | Daily maintain the continuous operation and security / resilience of 8 ports across the whole island and of 6 critical transit routes. Response: Within 8 hours (if necessary) conduct port inspections and certifications for operation. |
| Tsunami | Daily revision of ports (including airports) and pier infrastructure, and navigation buoys. Annual Coast Guard security inspection compliance. Response: Closure of San Juan Bay Area Port (Alternative Ports-Ponce, Mayaguez and Ceiba) Alternative Airport: Ceiba | Daily maintain the continuous operation and security / resilience of 8 ports across the whole island and of 6 critical transit routes. Response: Within 12-24 hours, conduct port inspections and certification for operation. |
| Cyber Attack | Daily revision of ports (including airports) and pier infrastructure, and navigation buoys. Annual Coast Guard security inspection compliance. Response: Activation of a Security Plan with PR Police Department and State National Guard for the protection of supply routes. Activation of the | Daily maintain the continuous operation and security / resilience of 8 ports across the whole island and of 6 critical transit routes. |

Supply Plan (PREMA)

## Community Resilience

**Capability Target:** Increase community resiliency educational campaigns thru radio, television and social media to general public and professional, volunteer, governmental and non-governmental organizations in order to persuade 100% of the population to be ready for a catastrophic event with supply emergency kits and family emergency plans.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | 100% population with supply emergency kits and family emergency plans. | Increase community resiliency educational campaigns thru radio, television and social media to general public and professional, volunteer, governmental and non-governmental organizations for the preparation and awareness of catastrophic events. |
| Earthquake | 100% population with supply emergency kits and family emergency plans. | Increase community resiliency educational campaigns thru radio, television and social media to general public and professional, volunteer, governmental and non-governmental organizations for the preparation and awareness of catastrophic events and persuade 100% of the population to have supply kits and family emergency plans. |
| Flood | 100% population with supply | Increase community resiliency educational |

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| | emergency kits and family emergency plans. | campaigns thru radio, television and social media to general public and professional, volunteer, governmental and non-governmental organizations for the preparation and awareness of catastrophic events and persuade 100% of the population to have supply kits and family emergency plans. |
| Tsunami | 100% population with supply emergency kits and family emergency plans. | Increase community resiliency educational campaigns thru radio, television and social media to general public and professional, volunteer, governmental and non-governmental organizations for the preparation and awareness of catastrophic events and persuade 100% of the population to have supply kits and family emergency plans. |
| Cyber Attack | 100% population with supply emergency kits and family emergency plans. | Increase community resiliency educational campaigns thru radio, television and social media to general public and professional, volunteer, governmental and non-governmental organizations for the preparation and awareness of catastrophic events and persuade 100% of the population to have supply kits and family emergency plans. |

## Long-term Vulnerability Reduction

**Capability Target:** Within two to five years, conduct educational programs and campaigns and develop a legislative tool to enforce the compliance of evacuation plans and simulation exercises in schools, commercial and work centers. Within five to ten years revise, update and restructure buildings that do not meet current building codes. Update every 5 years State and Municipal Mitigation Plans.

Develop mitigation programs for the evaluation of buildings that do not meet current construction codes. Establish "resistant quake areas" in places of high concentration of persons (commercial centers, schools, work places).

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
| --- | --- | --- |
| Hurricane / Typhoon | Update every 5 years State and Municipal Mitigation Plans. Revise and update Flood Maps if floods of great magnitude occur. | Annually (3 months before Hurricane Season), conduct ongoing educational campaigns for identified vulnerable communities in mitigation plans for floods, winds and landslides events during hurricanes; implement preventive maintenance measures to transportation infrastructures in the 78 municipalities; implement maintenance measures in PREPA power lines and maintenance of PR Aqueduct and Sewer Agency (PRASA) dams. |
| Earthquake | Update every 5 years State and Municipal Mitigation Plans. Develop mitigation programs for the evaluation of buildings that do not meet current construction codes. Establish resistant quake areas in places of high concentration of persons (commercial centers, schools, work places) | Within two to five years, conduct educational programs and campaigns and develop a legislative tool to enforce the compliance of evacuation plans and simulation exercises in schools, commercial and work centers. Within five to ten years revise, update and restructure buildings that do not meet current building codes. |
| Flood | Update every 5 years State and Municipal Mitigation Plans. Maintain rigor in use permits for urban developments and implement the National Flood Insurance Program. | Develop ongoing educational campaigns for identified vulnerable communities in mitigation plans for floods and landslides events. Implement maintenance measures of PR Aqueduct and Sewer Agency dams. |

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| Tsunami | Update every 5 years State and Municipal Mitigation Plans. All municipalities (78) incorporation to the tsunami ready program. | Within three to five years, conduct educational programs, campaigns and evacuation exercises and plans. Through the establishment of different scenarios, determine vulnerable areas as well as services. |
| Cyber Attack | N/A | N/A |

## Risk and Disaster Resilience Assessment

**Capability Target:** Maintain State and 78 Municipal Mitigation Risk Plans to identify vulnerabilities caused by natural and man-made events every 5 years.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Perform drill exercises, training and updates on Mitigation Plans every 5 years. | Maintain State and 78 Municipal Mitigation Risk Plans to identify vulnerabilities caused by natural and man-made events. |
| Earthquake | Perform drill exercises, training and updates on Mitigation Plans every 5 years. | Maintain State and 78 Municipal Mitigation Risk Plans to identify vulnerabilities caused by natural and man-made events. |
| Flood | Perform drill exercises, training and updates on Mitigation Plans every 5 years. | Maintain State and 78 Municipal Mitigation Risk Plans to identify vulnerabilities caused by natural and man-made events. |

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| Tsunami | Perform drill exercises, training and updates on Mitigation Plans every 5 years. | Maintain State and 78 Municipal Mitigation Risk Plans to identify vulnerabilities caused by natural and man-made events. |
| Cyber Attack | Perform drill exercises, training and updates on Mitigation Plans every 5 years. | Maintain State and 78 Municipal Mitigation Risk Plans to identify vulnerabilities caused by natural and man-made events. |

## Critical Transportation

**Capability Target:** Within 24-36 hours after the incident occurs, assess and restore 75% of critical transportation infrastructure impacted in the Metropolitan Area and surrounding municipalities and 60% of critical transportation infrastructure impacted in other municipalities to provide access to responders.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | 100% critical transportation infrastructure impacted. | 24 hours after the incident, assess and restore critical transportation assets to provide access to responders. |
| Earthquake | 75% of critical transportation infrastructure structural damages (road, expressways and bridges) in the Metropolitan Area and surrounding municipalities. 60% | Within 24-36 hours after the incident occurs, assess and restore critical transportation assets to provide access to responders. |

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| | of critical transportation infrastructure damages and impact from structural damages in roads and bridges and landslides in the other municipalities of the island. | |
| Flood | 60% of critical transportation infrastructure impacted island wide. | Within 24 hours, assess and restore critical transportation assets to provide access to responders. |
| Tsunami | 80 % of critical transportation infrastructure impacted in the municipalities reached by the tsunami. | 3 days after the incident, start conducting debris removal operations and assess and restore critical transportation assets. |
| Cyber Attack | Increase security in public transportation facilities (AMA Buses, Urban Train and Culebra and Vieques Transportation Ferry System). | Continue to provide transportation services to the public of the island. |

## Environmental Response/Health and Safety

**Capability Target:** Within 4 to 8 hours after the incident occurs, assess environmental and health/safety issues, perform an estimate of 100-150 preliminary environmental assessments around the whole island. Activation of the Operational Plan of the Agency and the Water, Air and Soil Emergency Programs and Protocols. Perform inspections to industries that have permits under the guidance of the Agency. Assess workers health/safety issues, and provide guidelines for implementation of non-

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| | | pharmaceutical interventions within 48 hours prior to public health emergency declaration. Provide the community, first responders & families, public health / healthcare workers and staff, guidelines to implement non-pharmaceutical interventions to reduce morbidity and mortality. Maintain interoperable communication with response agencies. |

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Perform an estimate of 100-150 preliminary environmental assessments around the whole island. Activation of the Operational Plan of the PR Environmental Quality Board and Water, Air and Soil emergency programs and protocols. Perform inspections to industries that have permits under the guidance of the Agency. Provide environmental and safety measures to priority personnel (responders and their families; Public Health staff and workers), and community within 12 hours after the incident. Maintain interoperable communication with response agencies. Population at risk: Pregnant woman, dialysis and ESRD patients and population under 14 years and above 65 years. | In 2 hours, the National Contingency Emergency Plan Activates. Within 4 to 8 hours after the incident occurs, assess environmental and health/safety issues. |

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| Earthquake | Perform an estimate of 50 preliminary environmental assessments. Activation of the Operational Plan of the Agency and the Water, Air and Soil emergency programs and protocols. Perform inspections to industries that have permits under the guidance of the Agency. Provide environmental and safety measures to priority personnel (responders and their families; Public Health staff and workers), and community within 12 hours after the incident. Maintain interoperable communication with response agencies. Population at risk: Pregnant woman, dialysis and ESRD patients and population under 14 years and above 65 years. | Assess environmental and health/safety issues within 4 to 8 hours after the incident occurs. |
| Flood | Perform an estimation of up to 50 preliminary environmental assessments. The agency will remain vigilant of water dam contamination and landslides. Regional offices of the PR Quality Board will be activated, if necessary, to attend each individual case. Provide environmental and safety | Assess environmental and health/safety issues within 2 to 4 hours after the incident occurs if necessary. |

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| | measures to priority personnel (responders and their families; Public Health staff and workers), and community. Possible population at risk: Pregnant woman, dialysis and ESRD patients and population under 14 years and above 65 years. | |
| Tsunami | Perform an estimate of 50+ preliminary environmental assessments. Activation of the Operational Plan of the Agency and the Water, Air and Soil emergency programs and protocols. Perform inspections to industries that have permits under the guidance of the Agency. Provide environmental and safety measures to priority personnel (responders and their families; Public Health staff and workers), and community within 24 hours after the incident. Maintain interoperable communication with response agencies. Activate the Local Emergency Planning Committee and maintain interoperable communication with other response agencies. Population at risk: Pregnant woman, dialysis and ESRD patients and population under 14 years and above 65 years. | In 12 hours after the incident occurs, assess environmental and health/safety issues. |
| Cyber Attack | Maintain interoperable communication with other response agencies. Stand by for activation. Perform an estimate of | Stand by and wait for activation by the Puerto Rico Police Department, Municipal Police, 911 or the Puerto Rico Emergency Management Agency if necessary. |

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| | 4 to 8 preliminary environmental assessments. | |

## Fatality Management Services

**Capability Target:** Within 24 hours, begin the fatality management process of recovering and identifying up to 90,000 corpses. Within 48 hours of the incident, notify family members, maintenance of corpses and begin burial process unless family members claim the body (of those identified) and assume responsibility.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Manage 200 corpses. | Within 24 hours begin the process of identifying fatalities. |
| Earthquake | Manage 90,000 corpses. | Within 24 hours begin the process of identifying fatalities. |
| Flood | Manage 200 corpses. | Within 24 hours begin the process of identifying fatalities. |
| Tsunami | Manage 45,000 corpses. | Within 24 hours begin the process of identifying fatalities. |
| Cyber Attack | Population at risk: 1,300,000 (Total Labor Force). Estimate based on the PR Integrated | Within 24 hours begin the process of identifying fatalities if necessary. |

## Infrastructure Systems

**Capability Target:** Within 3-4 days after the incident, conduct assessments and develop a plan with a specific timeline for redeveloping community infrastructure on power transmission and distribution. Also, repair and reduce vulnerability, giving priority to critical infrastructure systems in public safety agencies, hospitals, shelters, communications, schools, industries and bank institutions (1 million clients), PRASA will maintain at least 40% of potable water production (240 MGD).

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | 75% damage to transmission power lines (1 million affected power clients) 10 Mayor Water Sewage Plants affected and working at 50%, 2,688 water facilities impacted, 114 filtration plants and 723 sanitary bomb stations and 7 water dams impacted. (Approximately 80% clients without water). | Within 3-4 days after the incident, conduct air and land assessments on power transmission and distribution giving priority to water infrastructure agency, hospitals, shelters, security agencies, communication, industries and bank institutions. PRASA will maintain at least 40% of potable water production (240 MGD). Recovery: 100% of 10 Mayor Water Plants operating and producing 600 MGD, once all power from PREPA has been restored. |
| Earthquake | Instant power loss in the north of the island. 35% of power clients affected. 3 Sewerage plants, 191 facilities, 1 central office, 2 regional offices and 4 commercial offices of PRASA will be affected. | Immediately after the incident, conduct rapid assessments in power generation plants located in the north of the island (Palo Seco and San Juan). Within an hour of the incident, conduct rapid assessments on 32 water dams across the whole island. Within 1-2 days, conduct air and land assessments |

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| | | on power transmission and distribution giving priority to the water infrastructure agency, hospitals, shelters, security agencies, communication, industries and bank institutions. Within 72 hours, debris removal and assessments on the condition of affected sanitary plants, potable water and revision of the condition of submarine emissaries by PRASA. |
| Flood | 15% power clients without electricity. 308 PRASA facilities affected. | Within 4-6 hours after the rains stop, conduct air and land assessments for power damages, giving priority to the water infrastructure agency, hospitals, shelters, security agencies, communication, industries and bank institutions. Within 72 hours, 10 Mayor Sewage Water Plants recovery to a 100%. From 24 hours to 7 days, potable water distribution by trucks, use of emergency generators in facilities without power and damage assessments. |
| Tsunami | 35% power clients without electricity. Impacted generation plants: Palo Seco and San Juan. PRASA impacts: 10 Sewerage plants, 2 filter plants, 2 commercial offices, 2 dams and 31 autonomous facilities. | Within 1 week after the incident occurs, start cleaning power plants facilities and conducting assessment on damages in power generation. After 72 hours, debris removal, assessments on the condition of affected sanitary plants, potable water plants and revision of the condition of submarine emissaries by PRASA. |
| Cyber Attack | Critical infrastructure agencies are going to be unable to received payments from clients, make payments for operational purposes and fuel purchase for power generation. | Establishment of commercial emergency agreements with fuel suppliers to guarantee the continuity of power operations and activation of Alternate Plan of Financial Function Back up (for PRASA). |

## Mass Care Services

**Capability Target:** In 24 hours provide food, water and shelter to 500,000 people in need.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
| --- | --- | --- |
| Hurricane / Typhoon | 200,000 impacted population | In 24 hours provide food, water and shelter to people in need. |
| Earthquake | 350,000 impacted population. | In 24 hours provide food, water and shelter to people in need. |
| Flood | 50,000 impacted population | In 24 hours provide food, water and shelter to people in need. |
| Tsunami | 500, 000 impacted population | In 24 hours provide food, water and shelter to people in need. |
| Cyber Attack | Impacted Department of Housing Programs: Section 8 (10,000 families), Negative Rents on Public Housing facilities (20,000 families), Law 173 Program. | Activate a Special Emergency Plan. |

## Mass Search and Rescue Operations

**Capability Target:** Within 72 hours after the impact, conduct search and rescue operations, to rescue 12,000 persons in 1,400 completely collapse buildings, 20,000 people in 4,000 non-collapse buildings, 30,000 people in 5,000 buildings and 10,000 people from collapse light structures.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | 12,000 people in 1,400 completely collapse buildings. 20,000 people in 4,000 non- collapse buildings. 30,000 people in 5,000 buildings. 10,000 people from collapse light structures | 48 Hours before the hurricane impact: Alert and preparation time. Within 72 hours after the impact, conduct search and rescue operations. |
| Earthquake | 8,000 people in 1,000 completely collapse buildings. 10,000 people in 2,000 non-collapse buildings. 20,000 people in 5,000 buildings. 1,000 people from collapse light structures. | Within 72 hours after the earthquake impact, conduct search and rescue operations. |
| Flood | 500 people in 300 completely collapse buildings. 12,000 people in 5,000 non-collapse buildings. 1,000 people in 500 buildings. 1,000 people from collapse light structures. | Within 72 hours after the flood impact, conduct search and rescue operations. |
| Tsunami | 2,000 people in 500 completely | Within 72 hours after the tsunami impact, |

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| | collapsed buildings. 20,000 people in 5,000 non-collapse buildings. 25,000 people in 5,000 buildings. 1,000 people from collapse light structures. | conduct search and rescue operations. |
| Cyber Attack | 30,000 people in 8,000 non-collapse buildings. 30,000 people in 8,000 buildings. | Within 36 hours after the incident, conduct search and rescue operations. |

## Operational Communications

**Capability Target:** During the first 24 hours, establish operable voice communication between responders and Emergency response facilities, in the first 48 hours, establish the ability to communicate with the affected populations, and within 72 hours of the incident, establish interoperable voice and data communications between emergency responders and emergency response facilities.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | 100% of private communication facilities affected (wireless telephone towers, cable television) | During the first 24 hours, operable voice communication between responders and Emergency response facilities is established. During the first 48 hours, ability to communicate with the affected populations is established. Within 72 hours of the incident, interoperable voice and data communications between emergency responders and emergency response facilities are established. In 1-2 weeks, private communication facilities start to rise. |

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| Earthquake | Buried infrastructures, remote communication centers and submarine cable infrastructure will be impacted. Optical fiber services and wireless technologies will depend on the severity of power energy damages. | During the first 24 hours, operable voice communication between responders and Emergency response facilities is established. During the first 48 hours, ability to communicate with the affected populations is established. Within 72 hours of the incident, interoperable voice and data communications between emergency responders and emergency response facilities are established. In 1 week, private communication facilities start to rise. |
| Flood | Regional private communication infrastructure will be impacted by landslides and power outages. | During the first 24 hours, operable voice communication between responders and Emergency response facilities is established. During the first 48 hours, ability to communicate with the affected populations is established. Within 72 hours of the incident, interoperable voice and data communications between emergency responders and emergency response facilities are established. In 2 weeks, private communication facilities in the most affected areas (central region of PR) start to raise. |
| Tsunami | Buried infrastructures, remote communication centers and submarine cable infrastructure will be impacted as well as wireless or non-wireless infrastructures and communication nodes near the coast. | During the first 24 hours, operable voice communication between responders and Emergency response facilities is established. During the first 48 hours, ability to communicate with the affected populations is established. Within 72 hours of the incident, interoperable voice and data communications between emergency responders and emergency response facilities are established. In 3 months, private communication facilities start to raise. |

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| Cyber Attack | Protect all phases of the emergency manage cycle from cyber threats and hazards. Respond to incidents according to the PR Technology Agency Guidelines. | Within 24 hours of the incident, assess cyber threats and provide countermeasures in accordance with PR State Police and PR Justice Department to protect critical communication infrastructure. |

## Situational Assessment

**Capability Target:** Conduct situational reports every 4 hours to provide decision makers with timely and accurate information for lifesaving and life sustaining activities and stabilization of the incident.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Develop reports on the condition and status of critical infrastructures, coastal flooding, tourism activity, interstate commerce, sheltering, lifesaving activities and basic human needs. | Conduct situational reports every 4 hours. |
| Earthquake | Develop reports on the status and condition of critical infrastructures, communication infrastructure, sheltering necessities, lifesaving activities, and basic human needs. | Conduct situational reports every 4 hours. |
| Flood | Develop reports on the condition | Conduct situational reports every 4 hours. |

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| | and status of water provision infrastructure, transportation infrastructure, landslides, sheltering necessities, environmental pollution, agricultural loss, lifesaving activities, and basic human needs. | |
| Tsunami | Develop reports on number of fatalities, sheltering necessities, environmental pollution, communication infrastructure, critical infrastructures, coastal flooding, tourism activity, interstate commerce, lifesaving activities and basic human needs. | Conduct situational reports every 4 hours. |
| Cyber Attack | Develop reports on the condition and status of communication, infrastructure, security and law enforcement activities, vulnerability of sensitive information, vulnerability of commercial banking and money transactions and basic human needs. | Conduct situational reports every 4 hours. |

## Economic Recovery

**Capability Target:** After the incident has stabilized, conduct preliminary assessments of economic issues and develop an economic recovery plan to restore $92,000B in economic losses.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Economic impact and Restoration: 96,000M | After the incident has stabilized, conduct preliminary assessments of economic issues and develop an economic recovery plan. |
| Earthquake | Economic impact and Restoration: $92,000B. | After the incident has stabilized, conduct preliminary assessments of economic issues and develop an economic recovery plan. |
| Flood | Economic impact and Restoration: $30,000M | After the incident has stabilized, conduct preliminary assessments of economic issues and develop an economic recovery plan. |
| Tsunami | Immediate economic impact: $50,000M Long Term Economic impact and Restoration: $250,000M | After the incident has stabilized, conduct preliminary assessments of economic issues and develop an economic recovery plan. |
| Cyber Attack | The estimated economical loss will be of $10 Million on a daily basis. | After the incident has stabilized, conduct preliminary assessments of economic issues and develop an economic recovery plan. |

## Health and Social Services

**Capability Target:** Immediately after activation by the EOC, PR Family Department will start to assess necessities of families located in shelters, within 72 hours from the declaration of the State of Emergency from the Governor through an Executive Order, PR Family Department census process activates to identify necessities of families impacted by the event and provide emergency assistance. A Reunification Family Plan will activate once cases begin and within 1 week after the event, the Department of Health will provide mental health assistance to approximately 500,000 persons.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Provide mental health assistance to 200,000 people. Needed personnel to perform the necessity census: 40,000. | Immediately after activation by the EOC, PR Family Department will start to assess necessities of families located in shelters. Within 72 hours from the declaration of the State of Emergency from the Governor through an Executive Order, PR Family Department census process activates to identify necessities of families impacted by the event and provide emergency assistance. Reunification Family Plan will activate once cases begin and within 1 week after the event, provide mental health assistance to the affected population. |
| Earthquake | Provide mental health assistance | Immediately activated by the EOC, PR |

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| | to 300,000 people. Needed personnel to perform the necessity census: 10,000. | Family Department will start to assess necessities of the families located in shelters. Within 72 hours from the declaration of state of emergency from the Governor through an Executive Order, PR Family Department census process activates to identify necessities of families impacted by the event and provide emergency assistance. Reunification Family Plan will activate once cases begin and within 1 week after the event, provide mental health assistance to the affected population. |
| Flood | Provide mental health assistance to 50,000 people. Needed personnel to perform the necessity census: 40,000. | Immediately activated by the EOC, PR Family Department will start to assess necessities of the families located in shelters. Within 72 hours from the declaration of State of Emergency from the Governor through an Executive Order, PR Family Department census process activates to identify necessities of families impacted by the event and provide emergency assistance. Reunification Family Plan will activate once cases begin and within 1 week after the event, provide mental health assistance to the affected population. |
| Tsunami | Provide mental health assistance to 500,000 people. Needed personnel to perform the necessity census: 5,000. | Immediately activated by the EOC, PR Family Department will start to assess necessities of the families located in shelters. Within 72 hours from the |

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| | | declaration of State of Emergency from the Governor through an Executive Order, PR Family Department census process activates to identify necessities of families impacted by the event and provide emergency assistance. Reunification Family Plan will activate once cases begin and within 1 week after the event, provide mental health assistance to the affected population. |
| Cyber Attack | Population at risk: 1,300,000 (Total Labor Force). | Provide Social and Mental Health assistance to people in need. |

## Housing

**Capability Target:** 72 hours after the incident occurs, assess housing needs of sheltered people and 1,000,000 affected households, provide guidance on available housing assistance programs and identify temporary housing options for those who need longer alternatives.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Affected households: 200,000 | 72 hours after the incident occurs, assess housing needs of sheltered people, provide guidance on available housing assistance programs and identify temporary housing options for those who need longer alternatives. |
| Earthquake | Affected households: 1,000,000 | 72 hours after the incident occurs, assess housing needs of sheltered people, provide guidance on available housing assistance programs and identify temporary housing options for those who need longer |

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| | | alternatives. |
| Flood | Affected households: 80,000 | 72 hours after the incident occurs, assess housing needs of sheltered people, provide guidance on available housing assistance programs and identify temporary housing options for those who need longer alternatives. |
| Tsunami | Affected households: 375,000 | 72 hours after the incident occurs, assess housing needs of sheltered people, provide guidance on available housing assistance programs and identify temporary housing options for those who need longer alternatives. |
| Cyber Attack | N/A | N/A |

## Natural and Cultural Resources

**Capability Target:** Once the environmental assessments for hazardous material is conducted by the Environmental Quality Board and safety for operation is established, within 72 hours begin debris removal operations island wide, provide support to PREMA in debris removal in critical infrastructure, start conducting preliminary damage assessments in natural resources based on PREMA priorities and possible damage to DNER facility infrastructure and equipment.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / | Conduct landslide assessments | Within 48 hours of the incident, start |

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| Typhoon | island wide in vulnerable areas near properties or residential areas, including bodies of water under DNER jurisdiction. | conducting preliminary damage assessments on natural resources and high potential areas for possible landslides. |
| Earthquake | Conduct landslide assessments island wide in vulnerable areas near properties or residential areas, including bodies of water under DNER jurisdiction. | Within 48 hours of the incident, start conducting preliminary assessments as PREMA request it in landslide areas that can affect properties to determine if people need to be evacuated or relocated. |
| Flood | Monitor 14 Pump Stations island wide for the maintenance and level control of surface runoff for flood prevention on urban areas. | Immediately after the EOC is activated, status reports will be made on Pump Stations operated by the Department of Natural and Environmental Resources for flood control. |
| Tsunami | Possible damage to DNER facility infrastructure and equipment. Conduct debris removal operations island wide. Conducts damage assessments to natural resources island wide. | Once the environmental assessments for hazardous material is conducted by the Environmental Quality Board and safety for operation is established, within 72 hours begin debris removal operations, provide support to PREMA in debris removal in critical infrastructure and start conducting preliminary damage assessments based on PREMA priorities. |
| Cyber Attack | N/A | N/A |

## On-scene Security, Protection, and Law Enforcement

**Capability Target:** Within 30 minutes of a cyber-attack on banks, Police Department start investigation on the threat and in 45 minutes of the incident, 11,000 Puerto Rico Police Department Agents activate and take control of high risk areas establishing a safe and secure environment in the impacted areas to minimize future damage to persons and properties.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Activation of all Puerto Rico Police Department personnel (11,000 agents. All Police Department personnel to report to the closest police station from their homes. Production of reports of the necessities of the population by areas. | Law Enforcement Agency (Puerto Rico's Police Department) takes control of high risk areas within two hours. |
| Earthquake | Police agents of the Metropolitan Area will be impacted. Resources from other places of the island will be activated. Activation of all Puerto Rico Police Department available personnel (approx. 8,0009,000 agents). All Police Department personnel to report to the alternative designated Central Police Station. Production of reports of the necessities of the population by areas. | In one hour, designate an alternative Central Command Police Station outside of the impacted zone (Metropolitan Area) and law Enforcement agents take control of high risk areas. |
| Flood | Activation of all Puerto Rico Police Department personnel (11,000 agents). All Police Department personnel to report to the closest police station from their homes. Production of reports of the necessities of the population by areas. | Following the Emergency Command Center Activation, Police Department will be activated and will take control of high risk areas, in 5 hours the police will be activated. |
| Tsunami | Activation of all Puerto Rico Police | Once the earthquake event it's reported, Law |

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| | Department available personnel (approx. 11,000 agents) (Police agents located in tsunami prone areas will be impacted.) All available Police Department personnel to report to the closest police station from their homes. Production of reports of the necessities of the population by areas. | Enforcement Agency (Puerto Rico's Police Department) takes control of high risk areas within 45 minutes. |
| Cyber Attack | Activation of all Puerto Rico Police Department personnel (11,000 agents). All Police Department personnel to report to the closest police station. Production of reports of the necessities of the population by areas. | Puerto Rico's Bank Stealer Division (Roba Bancos) of the Police Department activates and starts working on an investigation of the threat in 30 minutes. Law enforcement personnel take control of high risk areas in 45 minutes. |

## Threats and Hazards Identification

**Capability Target:** Update and maintain state and municipal risk assessments and plans every 5 years and conduct a THIRA annually with whole community partners including academic and scientific entities, government and non-government agencies, ONG's and private sector to identify vulnerabilities and impacts of natural and man-made events.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Update Mitigation Plans every 5 years and THIRA annually. | Update and maintain state and municipal risk assessments and plans and conduct a THIRA with whole community partners including academic and scientific entities, government and non-government agencies, |

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| | | ONG's and private sector. |
| Earthquake | Update Mitigation Plans every 5 years and THIRA annually. | Update and maintain state and municipal risk assessments and plans and conduct a THIRA with whole community partners including academic and scientific entities, government and non-government agencies, ONG's and private sector. |
| Flood | Update Mitigation Plans every 5 years and THIRA annually. | Update and maintain state and municipal risk assessments and plans and conduct a THIRA with whole community partners including academic and scientific entities, government and non-government agencies, ONG's and private sector. |
| Tsunami | Update Mitigation Plans every 5 years and THIRA annually. | Update and maintain state and municipal risk assessments and plans and conduct a THIRA with whole community partners including academic and scientific entities, government and non-government agencies, ONG's and private sector. |
| Cyber Attack | Update Mitigation Plans every 5 years and THIRA annually. | Update and maintain state and municipal risk assessments and plans and conduct a THIRA with whole community partners including academic and scientific entities, government and non-government agencies, ONG's and private sector. |

## Fire Management and Suppression

**Capability Target:** Within 5 to 10 minutes after the incidents occurs, respond to all incident notified to conduct fire suppression operations and management.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Contract revision of 50+ suppliers of essential need products and services island wide. Possible 100+ fires due to the use of candles and generators. 75% clients without electricity power. Trees and debris will cause power lines fires. 75% Critical Transportation infrastructure impacted. Estimated population in need of services and assistance: 1 million. | Before the hurricane impact the Island, the fire Department will orientate the citizens about the use of power generator, candles and safety measures to be observed during the path of the storm and after it. Prior to the impact, the Fire Department will activate the personnel and quarter them during the path of the storm ensure to have enough personnel to respond. Two to four hours of the EOC activation, the Administration of General Services (GSA) starts working on the provision of essential services according to the population necessities and the emergency priorities. Puerto Rico's Fire Department (PRFD) will respond to emergencies during the path of the hurricane if the weather permits it. After the hurricane, the (PRFD) will respond to all emergency call transfers through the PREMA EOC and the 9-1-1 system. Within 2 hours after the incident, conduct debris removal on critical transportation assets to provide access to responder. |
| Earthquake | 80% Critical transportation | In 12 hours, GSA starts working on the |

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| | infrastructure damage (road, expressways and bridges) in the Metropolitan Area and surrounding municipalities. Too many damage will occurs in rural roads and rural housings. Possible 1,000+ fires of great magnitudes due to gas explosions in populated centers and commercial/industrial areas. More than 50,000 people reporting LP gas leaks in homes and commercial buildings. 35% of clients without electricity power. Estimated population in need of services and assistance: 1.5 million. | provision of essential services according to the population necessities and the emergency priorities. Within 2 hours after the incident, conduct debris removal on critical transportation assets to provide access to responder. Immediately after the incident occurs the PRDF will start responding to local incidents near to the fire stations and to the neighborhood close to it. 40 minutes approximately, the PRFD will start response operations once the island returns to normal conditions and the emergencies calls start flowing through the PREMA EOC and 9-1-1 System. |
| Flood | Possible limited fires 20+. 15% of clients without electricity power. Estimated population in need of services and assistance: 200,000. | Within 2 hours after the incident, conduct debris removal on critical transportation assets to provide access to responder. PRFD will activate immediately after emergency calls begin. |
| Tsunami | 80% of critical transportation infrastructure impacted in the municipalities reaches by the tsunami. Possible 20+ fires of moderate to low magnitude. 35% clients without electricity power. Estimated population in need of services and assistance: 600,000. | Immediately after the incident occurs (40 minutes approximately), the PRFD will start response operations once the island returns to normal conditions and the emergencies calls start flowing through the PREMA EOC and 9-1-1 System. Within 2 hours after the incident, conduct debris removal on critical transportation assets to provide access to responder. |
| Cyber Attack | Too many traffic jams due traffic light manipulated or out of service, cousin car accidents and vehicle fires. Possible 100+ fires of different magnitudes. Estimated population in need of services and assistance: 200,000. | PRFD will activate immediately after emergency calls begin. |

## Logistics and Supply Chain Management

**Capability Target:** Within the first 12 hours of an incident, deliver essential services and resources needed to save lives, attend 1,000 fires of great magnitude, restore power loss and meet the needs of 1.5 million of people across the whole island of Puerto Rico.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | Contract revision of 50+ suppliers of essential need products and services island wide. Possible 100+ fires due to the use of candles and generators. 75% clients without electricity power. Estimated population in need of services and assistance: 1 million. | Within two to four hours of the EOC activation, the Administration of General Services (AGS) starts working on the provision of essential services according to the population necessities and the emergency priorities. Puerto Rico's Fire Department (PRFD) will start operations once the EOC is activated until the island is returned to normal conditions. |
| Earthquake | Contract revision of 50+ suppliers of essential need products and services island wide. Possible 1,000+ fires of great magnitudes due to gas explosions in populated centers and commercial/industrial areas. 35% of clients without electricity power. Estimated population in need of services and assistance: 1.5 million. | In 12 hours, AGS starts working on the provision of essential services according to the population necessities and the emergency priorities. Immediately after the incident occurs (40 minutes approximately), the PRFD will start response operations until the island is returned to normal conditions. |
| Flood | Contract revision of 15+ suppliers | In one hour following the activation of the |

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|---|---|---|
| | of essential need products and services island wide. Possible limited fires 20+. 15% of clients without electricity power. Estimated population in need of services and assistance: 200,000. | EOC, AGS starts working on the provision of essential services according to the population necessities and the emergency priorities. PRFD will activate immediately after emergency calls begin. |
| Tsunami | Contract revision of 50+ suppliers of essential need products and services island wide. Possible 20+ fires of moderate to low magnitude. 35% clients without electricity power. Estimated population in need of services and assistance: 600,000. | In 12 hours after the incident, AGS starts working on the provision of essential services according to the population necessities and emergency priorities. Immediately after the incident occurs (40 minutes approximately), the PRFD will start response operations until the island is returned to normal conditions. |
| Cyber Attack | Contract revision of 50+ suppliers of essential need products and services island wide. Possible 100+ fires of different magnitudes. Estimated population in need of services and assistance: 200,000. | If activated by the EOC, within two to four hours AGS starts working on the provision of essential services according to the population necessities and the emergency priorities. PRFD will activate immediately after emergency calls begin. |

## Public Health, Healthcare, and Emergency Medical Services

**Capability Target:** Provide health and medical services to victims within 4 hours of event, establish TRIAGE systems at hospitals and manage 180,000 Injured persons (18,000 Urgent Care and 162,000 Non-Urgent). Within 48 hours after Public Health Emergency Declaration (PHED) initiate Mass Vaccination activities to provide lifesaving medical treatment for up to 1,500,000 persons around the Island. Incorporate all medical institutions, health professionals

and volunteers through hospital coalitions and MRC Medical Reserve Corps volunteer personnel.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Hurricane / Typhoon | 14,000 Injured (1,400 Urgent Care and 13,600 Non-Urgent). | Provide health and medical services to victims within 4 hours of the event. Establish TRIAGE systems at hospitals. |
| Earthquake | 180,000 Injured (18,000 Urgent Care and 162,000 Non-Urgent). | Provide health and medical services to victims within 4 hours of the event. Establish TRIAGE systems at hospitals. |
| Flood | 1,000 Injured (100 Urgent Care and 900 Non-Urgent). | Provide health and medical services to victims within 4 hours of the event. Establish TRIAGE systems at hospitals. |
| Tsunami | 90,000 Injured (9,000 Urgent Care and 81,000 Non-Urgent). | Provide health and medical services to victims within 4 hours of the event. Establish TRIAGE systems at hospitals. |
| Cyber Attack | Population at risk: 1,300,000 (Total Labor Force). | Provide health and medical services to victims within 4 hours of the event. Establish TRIAGE systems at hospitals. |

# THIRA Journal Notes

## On-scene Security and Protection

Information obtained by interview of Lt. Clarissa Ortz of the P.R. Police Department.

# THIRA Step 4: Apply the Results

**Puerto Rico**

## Planning

**Capability Target:** Prevention: Maintain 100% of state and local all-hazard Emergency Operations Plans that address all five mission areas (prevent, protect, mitigate, respond and recovery) with specific annexes as required. The plans identify critical objectives and provide the sequence and scope of tasks required to achieve the objectives. The plans are vertically and horizontally integrated with appropriate departments, agencies, and jurisdictions. The plans are reviewed every 2 years. Emergency Operations plans are implemented within reasonable timeframes when prior notice of an emergency event is confirmed or as soon as possible for unanticipated incidents. Mitigation: Develop, implement, evaluate and/or revise the jurisdiction's Hazard Mitigation Plan every 5 years. Support the development, implementation, evaluation and revision of All-Hazards Mitigation Plans for 78 local jurisdictions every 5 years. Protection: Three months before hurricane season, PREMA plans and assess operational zones and 78 municipalities for Emergency Operational Plan status and readiness for activation. Response: Maintain 100% of state and local all-hazard Emergency Operations Plans that address all five mission areas (prevent, protect, mitigate, respond and recovery) with specific annexes as required. The plans identify critical objectives and provide the sequence and scope of tasks required to achieve the objectives. The plans are vertically and horizontally integrated with appropriate departments, agencies, and jurisdictions. The plans are reviewed every 2 years. Emergency Operations Plans are implemented within reasonable timeframes when prior notice of an emergency event is confirmed or as soon as possible for unanticipated incidents. Recovery: Within 24 hours, convene the core of an inclusive planning team (identified pre-disaster) which will oversee disaster recovery planning. Within 30 days, develop a recovery strategy that provides and overall strategy and timeline, addresses all core capabilities, and integrates

socioeconomic, demographic, accessibility, community outreach, and risk assessment considerations, which will be implemented in accordance with the timeline contained in the plan.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Planning Section Chief (Type 3) | III | 13 |
| Incident Management | Planning Section Chief (Type 3) | | 15 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Geographic Info Systems and Info Technology | GIS Analyst | 15 |
| Incident Management | Web EOC Software | 1 |
| Incident Management | Trainings Specialist | 12 |
| Incident Management | Laptop with Wireless Capability and CAC Readers | 10 |
| Incident Management | Satellites Phones | 10 |
| Incident Management | EOC Planning Section Chief | 2 |
| Incident Management | Program Management Software | 10 |
| Other | Man Made Analyst | 15 |
| Other | Natural Event Analyst | 15 |

## Public Information and Warning

**Capability Target:** Prevention: Within 2 months, develop and implement a public awareness campaign to inform 3.5M people within the state of methods to identify and report suspicious activity to law enforcement entities through initiatives such as the DHS "See Something, Say Something Campaign or other similar program(s).Protection: Three minutes after the incident occurs, a news release is published thru radio, social media, press and television to provide information and public awareness to 100% of the population. In case of power outages, the news will be delivered by phone. Mitigation: Every year, conduct 2 public information and warning campaigns to provide 3.1M people within the jurisdiction with useful and relevant information on the threats and hazards faced by the community and how to prepare for them. Response: Three minutes after the incident occurs, a news release is published thru radio, social media, press and television to provide information and public awareness to 100% of the population. In case of power outages, the news will be delivered by phone. Recovery: Within 3 months after the incident occurs, a news release is published thru radio, social media, press and television or another mass notification system with deliver credible, recovery-based, accessible messages in order to facilitate the transition from response to recovery, and to inform the public of all available recovery funds and resources in coordination with all ESF-14 partners, across all sectors.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Public Information Officer (Type 3) | | 25 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

| | | |
|---|---|---|
| Other | Satellite Phone | 4 |
| Other | Computers/Laptops | 30 |
| Other | Printers | 5 |

## Operational Coordination

**Capability Target:** Prevention: Within 2 hours of receipt of information about a credible threat of imminent attack, establish operations with functional and integrated communications between the Incident Command Structure, State Information and Analysis Center, State EOCs, 78 Local EOCs and other stakeholder Multi-Agency Coordination groups at the Federal, state and local levels to coordinate investigation, intelligence gathering, and other prevention activities at all levels. Protection: Establish and maintain a unified and coordinated multi-agency operational structure and process five 5 days prior to an anticipated incident or within two hours after an incident has begun or concluded, that integrates 100% of critical stakeholders and support the execution of core capabilities. Mitigation: 12 weeks prior to a National Special Security Event, Fusion Center will develop and disseminate a special event threat assessment to relevant stakeholders in an attempt to provide situational awareness that could assist in disrupting or deterring a potential terrorist attack. Response: Immediately after the incident, all emergency management personnel become activated and must report to the Emergency Operation Center (EOC) for the establishment of command, control and coordination structures. In 4-5 hours after the incident occurs, priority missions such as search and rescue, fire extinction and the establishment of shelters begin. In 24 hours, the state EOC becomes fully activated with 50 government agencies, 15 ESF's, FEMA, 78 municipalities, Red Cross, Salvation Army and voluntary groups (VOAD's) to meet human needs and stabilize the incident until recovery activities are finalize. If the current

state EOC is inoperable, an alternate EOC will be activated. Recovery: Within 30 days of the opening of the Joint Field Office (JFO) in each jurisdiction, define the path and timeline for recovery leadership to achieve the jurisdiction's objectives and effectively coordinate and use appropriate assistance from 10 Federal, 30 states, and 78 local entities, as well as nongovernmental and private sector resources.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Geographic Info Systems and Info Technology | GIS Analyst | 2 |
| Incident Management | Communications Support Team (CAP) | 3 |
| Incident Management | Mobile Communications Center (Mobile | 3 |
| Public Works | Repair Restoration Team- Communications | 3 |
| Public Works | Disaster Management Recovery Team | 4 |
| Public Works | Structure Condition Evaluator | 4 |
| Search and Rescue | Disaster Collapse Structure Canine Structure Canine Search Technical Specialist (Advisor) | 12 |
| Search and Rescue | Logistics Search and Rescue Technician | 12 |

| | | |
|---|---|---|
| Search and Rescue | Disaster Collapse Structure Canine Search Technician | 12 |
| Search and Rescue | Structural Collapse Rescue Team | 5 |
| Search and Rescue | Canine Search and Rescue Team- Disaster Response | 12 |
| Search and Rescue | Urban Search and Rescue (US&R) Task Force | 5 |
| Search and Rescue | Emergency Services Rescue Manager | 12 |
| Search and Rescue | Disaster Collapse Structure Canine Search Manager | 12 |
| Search and Rescue | Emergency Services Rescue Technician | 12 |

## Forensics and Attribution

**Capability Target:** Within 24 hours in coordination with state and federal law enforcement agencies, activate emergency technology equipment for conducting digital media and network exploitation and forensic investigation for determination of the nature and scope of the attack, and fuse intelligence, law enforcement information and technical forensic conclusion to develop attribution assessments.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Intelligence and Information Sharing

**Capability Target:** Within 1-3 hours of receiving actionable intelligence or information, PR Fusion Center elaborates and disseminates a Situational Awareness report and Awareness Notes (updates to the situation) to state and local law enforcement agencies, federal partners and local Bank Security Committees.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Interdiction and Disruption

**Capability Target:**

Prevention: Establish a Security Operational Center (SOC) that operates 24 hours 7 days of the week, to monitor and prevent possible threats, private sector should implement aggressive policies and practical guides for information systems and response on threats. Protection: Implement Identify, Protect Detect, Respond and Recover Protocol, create a State Computer Security Incident Response Team and legislation that forces private and state entities to share information on threats and report incidents made to the information systems to the Police Department.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Screening, Search, and Detection

**Capability Target:**

Continually screen and monitor suspicious groups and persons with high potential for criminal cyber acts, maintain a statistical base and reports of criminal groups and persons, identify hacker operational modes and possible future motivations and achieve collaborative agreements with government agencies and private sector for reporting threats and criminal acts to PR Police Department and Fusion Center.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

# Access Control and Identity Verification

**Capability Target:** Maintain a system of authentication to ensure identity verification and authorize access or immediately block if a threat is identified by implementing different credential revision options like 3 way/factor authentication /authorization system, 8 digit /complex passwords, and credential verification for network access and withdrawal.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Cybersecurity

**Capability Target:** Protect and maintain cyber access control measures of networks and systems in 100% of bank and financial institutions in Puerto Rico.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Physical Protective Measures

**Capability Target:** Implement and maintain physical security measures, policies and procedures and adoption of particular/individual identity verification methods like magnetic cards, voice, fingerprints or handwritings to control access to networks, systems and other bank and financial infrastructures.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Risk Management for Protection Programs and Activities

**Capability Target:** Complete, review and update risk assessments on 100% of banks, financial institutions and other critical infrastructure that can be affected by a cyberattack of this kind to identify protective measures.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Supply Chain Integrity and Security

**Capability Target:** Daily assess and maintain the continuous operation and security/resilience of 8 ports across the whole island and of 6 critical transit routes. After an incident, within 12-24 hours, conduct port inspections and certification for reopening and operation.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Community Resilience

**Capability Target:** Increase community resiliency educational campaigns thru radio, television and social media to general public and professional, volunteer, governmental and non-governmental organizations in order to persuade 100% of the population to be ready for a catastrophic event with supply emergency kits and family emergency plans.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

# Long-term Vulnerability Reduction

**Capability Target:** Within two to five years, conduct educational programs and campaigns and develop a legislative tool to enforce the compliance of evacuation plans and simulation exercises in schools, commercial and work centers. Within five to ten years revise, update and restructure buildings that do not meet current building codes. Update every 5 years State and Municipal Mitigation Plans. Develop mitigation programs for the evaluation of buildings that do not meet current construction codes. Establish "resistant quake areas" in places of high concentration of persons (commercial centers, schools, work places).

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Risk and Disaster Resilience Assessment

**Capability Target:** Maintain State and 78 Municipal Mitigation Risk Plans to identify vulnerabilities caused by natural and man-made events every 5 years.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Critical Transportation

**Capability Target:** Within 24-36 hours after the incident occurs, assess and restore 75% of critical transportation infrastructure impacted in the Metropolitan Area and surrounding municipalities and 60% of critical transportation infrastructure impacted in other municipalities to provide access to responders.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Public Works | Buses | III | 10 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Public Works | Lightweight Pick ups | 100 |
| Public Works | Dump truck Operators | 200 |
| Public Works | Wheel Loader (Med) | 35 |
| Public Works | Equipment Operators | 40 |
| Public Works | Water Pumps 6 | 50 |
| Public Works | Label | 100 |
| Public Works | Excavator | 35 |
| Public Works | Carpenter | 70 |
| Public Works | Water Pumps 4" | 50 |
| Public Works | Diggers | 35 |
| Public Works | Foreman/Supervisor | 50 |
| Public Works | Dump trucks | 200 |
| Public Works | Platforms | 10 |
| Public Works | Welder | 50 |
| Public Works | Builder | 70 |

## Environmental Response/Health and Safety

**Capability Target:** Within 4 to 8 hours after the incident occurs, assess environmental and health/safety issues, perform an estimate of 100-150 preliminary environmental assessments around the whole island. Activation of the Operational Plan of the Agency and the Water, Air and Soil Emergency Programs and Protocols. Perform inspections to industries that have permits under the guidance of the Agency. Assess workers health/safety issues, and provide guidelines for implementation of non-pharmaceutical interventions within 48 hours prior to public health emergency declaration. Provide the community, first responders & families, public health / healthcare workers and staff, guidelines to implement non-pharmaceutical interventions to reduce morbidity and mortality. Maintain interoperable communication with response agencies.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Medical and Public Health | Air Monitoring Equipment (Mini ray) | 12 |
| Medical and Public Health | Environmental Health Team Type II | 5 |
| Medical and Public Health | Pickup Trucks | 5 |
| Medical and Public | Environmental Health Team Type I | 10 |

| | | |
|---|---|---|
| Health | | |
| Medical and Public Health | Trucks | 5 |
| Medical and Public Health | 4x4 Vehicles inspection type | 45 |
| Medical and Public Health | PH Meter | 12 |

## Fatality Management Services

**Capability Target:** Within 24 hours, begin the fatality management process of recovering and identifying up to 90,000 corpses. Within 48 hours of the incident, notify family members, maintenance of corpses and begin burial process unless family members claim the body (of those identified) and assume responsibility.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Medical and Public Health | NDMS Deployable Morgue Unit (DPMU) | 11 |
| Medical and Public Health | NDMS Disaster Mortuary Operational Response Team (DMORT) | 11 |

## Infrastructure Systems

**Capability Target:** Within 3-4 days after the incident, conduct assessments and develop a plan with a specific timeline for redeveloping community infrastructure on power transmission and distribution. Also, repair and reduce vulnerability, giving priority to critical infrastructure systems in public safety agencies, hospitals, shelters, communications, schools, industries and bank institutions (1 million clients), PRASA will maintain at least 40% of potable water production (240 MGD).

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Public Works | Aerial Lift - Truck Mounted | I | 35 |
| Public Works | Water Pumps, De-Watering | I | 100 |
| Public Works | Truck, Sewer Flusher | I | 65 |
| Public Works | Cranes, All Terrain & Rough Terrain | I | 172 |
| Public Works | Trailer, Small Equipment | I | 10 |
| Public Works | Trailer, Equipment Tag-Trailer | I | 12 |
| Public Works | Hydraulic Excavator (Compact Short Radius 1.75 cy to 0.62 cy Buckets) | I | 4 |
| Public Works | Floodlights | I | 30 |
| Public Works | Wheel Loader Backhoe | I | 40 |

| | | | |
|---|---|---|---|
| Public Works | Wheel Loaders, Telescopic Handler | I | 12 |
| Public Works | Wheel Loaders (Medium 7 cy to 3 cy) | I | 99 |
| Public Works | Truck, Off-Road Dump | I | 239 |
| Public Works | Trailer, Dump (one type/example only) | I | 8 |
| Public Works | Trailer, Flat Bed Truck (Two Types/Example Only) | I | 25 |
| Public Works | Hydraulic Excavator Truck Mounted | I | 9 |
| Public Works | Trailer, Gooseneck Tractor | I | 25 |
| Public Works | Track Loader | I | 2 |
| Public Works | Generators | I | 10 |
| Public Works | Track Dozer | I | 2 |
| Public Works | Wood Chipper | I | 70 |
| Public Works | Truck, Off-Road Dump | II | 15 |
| Public Works | Hydraulic Excavator (Large Mass Excavation 13 cy to 3 cy buckets) | II | 9 |
| Public Works | Trailer, Flat Bed Truck (Two Types/Example Only) | II | 25 |
| Public Works | Track Loader | II | 8 |
| Public Works | Truck, Tractor Trailer | II | 25 |

| | | | |
|---|---|---|---|
| Public Works | Aerial Lift - Articulating Boom | II | 28 |
| Public Works | Trailer, Small Equipment | II | 10 |
| Public Works | Water Pumps, De-Watering | II | 150 |
| Public Works | Wheel Dozer | II | 12 |
| Public Works | Wheel Loaders (Medium 7 cy to 3 cy) | II | 30 |
| Public Works | Water Pumps, De-Watering | III | 200 |
| Public Works | Track Dozer | III | 8 |
| Public Works | Air Compressor | III | 15 |
| Public Works | Aerial Lift - Truck Mounted | IV | 60 |
| Public Works | Buses | IV | 30 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Other | Plant Operators | 841 |
| Public Works | Repair and Restoration Team SCADA | 80 |
| Public Works | Pipe Fitter | 374 |
| Public Works | Chemist | 15 |
| Public Works | Mechanic | 41 |

| | | |
|---|---|---|
| Public Works | Mobile Compressor | 98 |
| Public Works | Engineers | 31 |
| Public Works | Digger | 170 |
| Public Works | Electrician | 221 |
| Public Works | Operational System Workers | 570 |

## Mass Care Services

**Capability Target:** In 24 hours provide food, water and shelter to 500,000 people in need.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Mass Care Services | Field Kitchen Manager | I | 500 |
| Mass Care Services | Shelter Management Team (Mass Care) | II | 50 |
| Mass Care Services | Field Kitchen Unit | III | 125 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Mass Care Services | Generators High Capacity | 500 |
| Mass Care Services | Shower Unit | 1,000 |

| | | |
|---|---|---|
| Mass Care Services | Portable Bed | 400,000 |
| Mass Care Services | Mobile Kitchen Unit | 250 |
| Mass Care Services | Laundry Unit | 250 |
| Mass Care Services | Shelter Function Leader | 1,800 |
| Mass Care Services | Shelter Manager (Type 1) | 1,800 |
| Mass Care Services | Temporary Child Care Support Services Team | 250 |
| Other | Water Bottles (daily) | 1,500,000 |

## Mass Search and Rescue Operations

**Capability Target:** Within 72 hours after the impact, conduct search and rescue operations, to rescue 12,000 persons in 1,400 completely collapse buildings, 20,000 people in 4,000 non-collapse buildings, 30,000 people in 5,000 buildings and 10,000 people from collapse light structures.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Search and Rescue | Structural Collapse Search Team Leader | I | 20 |
| Search and Rescue | Urban Search and Rescue (US&R) Task Force Leader | I | 10 |
| Search and Rescue | Canine Search and Rescue Team Disaster Response | I | 20 |
| Search and Rescue | Structural Collapse Rescue Team Leader | I | 20 |

| | | | |
|---|---|---|---|
| Search and Rescue | Structural Collapse - Rescue Technician | II | 100 |
| Search and Rescue | Structural Collapse Search Technician | II | 100 |
| Search and Rescue | Urban Search and Rescue (US&R) Task Force | n/a | 38 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Operational Communications

**Capability Target:** During the first 24 hours, establish operable voice communication between responders and Emergency response facilities, in the first 48 hours, establish the ability to communicate with the affected populations, and within 72 hours of the incident, establish interoperable voice and data communications between emergency responders and emergency response facilities.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Incident Management | UHF P-25 Repeaters | 2 |

| | | |
|---|---|---|
| Incident Management | VHF P-25 Repeaters | 2 |
| Incident Management | Tower trailers with generators | 9 |
| Incident Management | Portable Radio 800 MHz P-25 | 300 |
| Incident Management | Portable Radio 700 MHz P-25 | 300 |
| Incident Management | Portable Radio UHF P-25 | 300 |
| Incident Management | Portable Radio VHF P-25 | 300 |
| Incident Management | 800 MHz P-25 Repeaters | 2 |
| Incident Management | 700MHz P-25 Repeaters | 2 |

## Situational Assessment

**Capability Target:** Conduct situational reports every 4 hours to provide decision makers with timely and accurate information for lifesaving and life sustaining activities and stabilization of the incident.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Rapid Needs Assessment Team | I | 12 |
| Incident Management | Donations Management Personnel/Team | II | 12 |
| Incident Management | Communications Support Team (CAP) | II | 12 |

| | | | |
|---|---|---|---|
| Incident Management | Planning Section Chief (Type 3) | III | 12 |
| Incident Management | EOC Management Support Team | III | 12 |

**Other Resources**

| Category: | Resource: | Number Required: |
|---|---|---|
| Geographic Info Systems and Info Technology | GIS Analyst | 4 |
| Incident Management | EOC Planning Section Chief (Type II) | 2 |

## Economic Recovery

**Capability Target:** After the incident has stabilized, conduct preliminary assessments of economic issues and develop an economic recovery plan to restore $92,000B in economic losses.

**NIMS-typed Resources**

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Donations Management Personnel/Team | I | 12 |
| Incident Management | EOC Finance / Administration Section Chief / Coordinator | I | 5 |
| Incident Management | Finance/Administration Section Chief (Type 3) | III | 30 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Incident Management | Donations Coordinator (Type I) | 12 |
| Other | Economic Restoration and Development Task Force | 12 |

# Health and Social Services

**Capability Target:** Immediately after activation by the EOC, PR Family Department will start to assess necessities of families located in shelters, within 72 hours from the declaration of the State of Emergency from the Governor through an Executive Order, PR Family Department census process activates to identify necessities of families impacted by the event and provide emergency assistance. A Reunification Family Plan will activate once cases begin and within 1 week after the event, the Department of Health will provide mental health assistance to approximately 500,000 persons.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Donations Management Personnel/Team | I | 12 |
| Medical and Public Health | Dietician/Nutritionist | I | 30 |
| Medical and Public Health | Behavioral Health Specialist, Licensed | I | 25 |
| Medical and Public Health | Public Health and Medical Team in a Shelter | I | 25 |

| | | | |
|---|---|---|---|
| Medical and Public Health | Palliative Care/Hospice Team | I | 12 |
| Medical and Public Health | Behavioral Health Specialist, Unlicensed | I | 75 |
| Medical and Public Health | Public Health Disaster Assessor | I | 12 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Mass Care Services | Necessity Census Team | 18,000 |
| Mass Care Services | 4x4 Vehicles | 100 |
| Medical and Public Health | Crisis Incident Stress Management Team Type II | 24 |
| Medical and Public Health | Crisis Incident Stress Management Team Type I | 12 |

## Housing

**Capability Target:** 72 hours after the incident occurs, assess housing needs of sheltered people and 1,000,000 affected households, provide guidance on available housing assistance programs and identify temporary housing options for those who need longer alternatives.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Other | Planners | 40 |
| Public Works | Structural Engineers | 100 |

# Natural and Cultural Resources

**Capability Target:** Once the environmental assessments for hazardous material is conducted by the Environmental Quality Board and safety for operation is established, within 72 hours begin debris removal operations island wide, provide support to PREMA in debris removal in critical infrastructure, start conducting preliminary damage assessments in natural resources based on PREMA priorities and possible damage to DNER facility infrastructure and equipment.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Animal Emergency Response | Veterinarian | I | 3 |
| Animal Emergency Response | Animal Disease Epidemiologist | I | 2 |
| Animal Emergency Response | Incident Management Team Animal Protection | II | 12 |
| Incident Management | EOC Management Support Team | II | 12 |

| | | | |
|---|---|---|---|
| Incident Management | Mobile Communications Center (Also referred to as "Mobile EOC") | III | 7 |
| Incident Management | Communications Support Team (CAP) | | 12 |
| Public Works | Wheel Loader Backhoe | I | 3 |
| Public Works | Hydraulic Excavator (Large Mass Excavation 13 cy to 3 cy buckets) | I | 7 |
| Public Works | Equipment Operator | I | 14 |
| Public Works | Trailer, Flat Bed Truck (Two Types/Example Only) | I | 3 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Animal Emergency Response | National Veterinary Response Team | 5 |
| Animal Emergency Response | Animal Shelter Manager | 2 |
| Animal Emergency Response | Exotic and Wildlife Animal Protection: Small Animal Sheltering Type II | 12 |
| Animal Emergency Response | Exotic and Wildlife Animal Protection: Large Animal Sheltering Type II | 12 |
| Animal Emergency Response | Wildlife Control Specialist | 12 |
| Incident Management | Natural Resources Department Recovery Teams | 20 |
| Public Works | Water Pumps De-Watering 10,000 (GPM) | 1 |

| | | |
|---|---|---|
| Public Works | Water Pumps De-Watering 30,000 (GPM) | 32 |
| Public Works | Maintenance Truck | 1 |
| Public Works | Transcavator | 2 |

## On-scene Security, Protection, and Law Enforcement

**Capability Target:** Within 30 minutes of a cyber-attack on banks, Police Department start investigation on the threat and in 45 minutes of the incident, 11,000 Puerto Rico Police Department Agents activate and take control of high risk areas establishing a safe and secure environment in the impacted areas to minimize future damage to persons and properties.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Mobile Communications Center (Also referred to as "Mobile EOC") | I | 2 |
| Incident Management | Mobile Communications Center (Also referred to as "Mobile EOC") | II | 26 |
| Law Enforcement Operations | SWAT/Tactical Teams | I | 20 |
| Law Enforcement Operations | Public Safety Dive Team | I | 20 |
| Law Enforcement Operations | Bomb Squad/Explosives Team | II | 28 |
| Law Enforcement Operations | Law Enforcement Observation Aircraft (Fixed-Wing) | II | 6 |

| | | | |
|---|---|---|---|
| Law Enforcement Operations | Mobile Field Force Law Enforcement (Crowd Control Teams) | II | 500 |
| Law Enforcement Operations | Law Enforcement Aviation - Helicopters - Patrol & Surveillance | II | 160 |
| Law Enforcement Operations | Law Enforcement Patrol Team (Strike Team) | | 1,000 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Law Enforcement Operations | Radio Communications | 9,000 |
| Law Enforcement Operations | Vehicle Tow Units (Platform) | 42 |
| Law Enforcement Operations | Police Rescue Units | 6 |
| Law Enforcement Operations | Personal Water Craft | 25 |
| Law Enforcement Operations | High Speed Patrol Boat | 14 |

## Threats and Hazards Identification

| | |
|---|---|
| **Capability Target:** | Update and maintain state and municipal risk assessments and plans every 5 years and conduct a THIRA annually with whole community partners including academic and scientific entities, government and non-government agencies, ONG's and private sector to identify vulnerabilities and impacts of natural and man-made events. |

| NIMS-typed Resources | | | |
|---|---|---|---|
| **Category:** | **Resource:** | **Type:** | **Number Required:** |
| | **No Response** | | |

| Other Resources | | |
|---|---|---|
| **Category:** | **Resource:** | **Number Required:** |
| | **No Response** | |

## Fire Management and Suppression

**Capability Target:** Within 5 to 10 minutes after the incidents occurs, respond to all incident notified to conduct fire suppression operations and management.

| NIMS-typed Resources | | | |
|---|---|---|---|
| **Category:** | **Resource:** | **Type:** | **Number Required:** |
| Fire/Hazardous Materials | Firefighter | II | 3,000 |

| Other Resources | | |
|---|---|---|
| **Category:** | **Resource:** | **Number Required:** |
| Fire/Hazardous Materials | Rehab Trucks | 12 |
| Fire/Hazardous Materials | Medium Rescue Fire Trucks | 97 |
| Fire/Hazardous Materials | Tankers | 96 |

| | | |
|---|---|---|
| Fire/Hazardous Materials | Heavy Rescue Fire Trucks | 30 |
| Fire/Hazardous Materials | Air Supply Units | 24 |
| Fire/Hazardous Materials | Fire Truck - Aerial (Ladder or Platform) | 24 |
| Fire/Hazardous Materials | Engine, Fire Pumper | 194 |

## Logistics and Supply Chain Management

**Capability Target:** Within the first 12 hours of an incident, deliver essential services and resources needed to save lives, attend 1,000 fires of great magnitude, restore power loss and meet the needs of 1.5 million of people across the whole island of Puerto Rico.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Fire/Hazardous Materials | Firefighter | II | 3,000 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Fire/Hazardous Materials | Air Supply Units | 12 |
| Fire/Hazardous Materials | Heavy Rescue Fire Trucks | 40 |
| Fire/Hazardous Materials | Medium Rescue Fire Trucks | 100 |

| | | |
|---|---|---|
| Fire/Hazardous Materials | Tankers | 100 |
| Fire/Hazardous Materials | Fire Truck - Aerial (Ladder or Platform) | 20 |
| Fire/Hazardous Materials | Engine, Fire Pumper | 200 |
| Fire/Hazardous Materials | Rehab Trucks | 12 |

## Public Health, Healthcare, and Emergency Medical Services

**Capability Target:** Provide health and medical services to victims within 4 hours of event, establish TRIAGE systems at hospitals and manage 180,000 Injured persons (18,000 Urgent Care and 162,000 Non-Urgent). Within 48 hours after Public Health Emergency Declaration (PHED) initiate Mass Vaccination activities to provide lifesaving medical treatment for up to 1,500,000 persons around the Island. Incorporate all medical institutions, health professionals and volunteers through hospital coalitions and MRC Medical Reserve Corps volunteer personnel.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Medical and Public Health | Mass Dispensing Consultant Team | I | 3 |
| Medical and Public Health | Medical/Public Health System Assessment Team | I | 3 |
| Medical and Public Health | Mass Dispensing Consultant Team | II | 7 |
| Medical and Public | Epidemiology (Surveillance and | II | 5 |

| | |
|---|---|
| Health | Investigation) |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Medical and Public Health | Public Health/Epidemiology (Surveillance & Investigation) Type II | 5 |

# THIRA Post-Assessment

**Puerto Rico**

## Number of Participating Agencies Data

### Federal

#### Emergency Management / Homeland Security

0

#### Fusion Center

0

#### Law Enforcement / Public Safety

0

#### Fire / EMS

0

#### Public Health

0

#### Historic / Cultural Resources

0

#### Environment

0

#### Transportation

0

#### Agriculture

0

#### Executive Branch

0

#### Social Services/Family

0

#### Aqueduct and Sewer

0

#### Ports Authority

0

#### Housing

0

## General Services

0

## Electric Power

0

## Telecommunications

0

# State

## Emergency Management / Homeland Security

2

## Fusion Center

1

## Law Enforcement / Public Safety

2

## Fire / EMS

1

## Public Health

1

## Historic / Cultural Resources

0

## Environment

2

## Transportation

1

## Agriculture

0

## Executive Branch

1

## Social Services/Family

1

## Ports Authority

1

## Aqueduct and Sewer

1

## Housing

1

## Telecommunications

1

## General Services

1

## Electric Power

1

# Territory

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Aqueduct and Sewer

0

## Social Services/Family

0

## Ports Authority

0

## Telecommunications

0

## General Services

0

## Electric Power

0

## Housing

0

# County

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Social Services/Family

0

## Ports Authority

0

## Aqueduct and Sewer

0

## Housing

0

## Telecommunications

0

## General Services

0

## Electric Power

0

# UASI

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Social Services/Family

0

## Ports Authority

0

## Aqueduct and Sewer

0

## Housing

0

## Telecommunications

0

## General Services

0

## Electric Power

0

# Other City

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Social Services/Family

0

## Ports Authority

0

## Aqueduct and Sewer

0

## Housing

0

## Electric Power

0

## Telecommunications

0

## General Services

0

# Tribal

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Social Services/Family

0

## Ports Authority

0

## Aqueduct and Sewer

0

## Housing

0

## General Services

0

## Electric Power

0

## Telecommunications

0

## Other (specify)

### Emergency Management / Homeland Security

0

### Fusion Center

0

### Law Enforcement / Public Safety

0

### Fire / EMS

0

### Public Health

0

### Historic / Cultural Resources

0

### Environment

0

### Transportation

0

### Agriculture

0

### Executive Branch

0

## Non-Governmental Organizations

### American Red Cross

0

### Other (specify)

0

### Port authority / Other port organization

0

### Private sector / Business

3

### Utilities / Public works

0

## Hospital / Healthcare organization

0

## Education community

0

## Community advocacy group

0

## Disability or access / functional needs community

0

## Other VOAD

1

## Faith-based organization

0

## Other (specify)

## Social Services/Family

0

## Ports Authority

0

## Aqueduct and Sewer

0

## Housing

0

## Telecommunications

0

## General Services

0

## Electric Power

0

## Social Services/Family

0

## Ports Authority

0

## Aqueduct and Sewer

0

## General Services

0

## Electric Power

0

## Housing

0

## Telecommunications

0

# THIRA Post-Assessment Resources

| | |
|---|---|
| Participant List: | N/A |
| Data Sources: | Interviews, Questionnaires, Reports, Protocols and Plans. |
| Limitations: | none |

# THIRA Post-Assessment Modeling Tools

| | |
|---|---|
| ALOHA | not checked |
| DHS One View | not checked |
| Flood Maps | checked |
| HAZUS MH | not checked |
| HURREVAC | not checked |

| | |
|---|---|
| Landscan USA | not checked |
| National Climate Assessment Report | checked |
| SLOSH | not checked |
| Sea Level Rise Viewer | not checked |
| Corps of Engineers Debris Model | not checked |
| None | not checked |
| Other | not checked |
| Other Specification | N/A |

## THIRA Post-Assessment Climate Change Data

| | |
|---|---|
| Were Impacts of Climate Change Included? | Yes |
| Step 1 | checked |
| Step 2 | checked |
| Step 3 | checked |
| Step 4 | checked |
| Describe | Climate change considerations included were based on the findings of the Puerto Rico Climate Change Council. According to the Council, "temperatures are increasing, precipitation patterns are changing, extreme events are occurring more frequently and sea level is rising in the Caribbean. They also state that many climate change impacts are likely to |

affect island communities in the Caribbean, including higher sea levels, more powerful tropical storms, extreme precipitation and extreme temperatures events (2010-2013). Other impacts found were an increased in regional downpours, particularly in May, increment in hurricane intensity (a global increased in 40% of Category 3 and stronger hurricanes), and thermal cracking on cement structures and asphalt roads due to high temperature events. For THIRA 2015 these climate change impacts were integrated into Step 1 and Step 2. In Step 1, climate change considerations helped to determine and identify extreme weather events that were included as natural threat and hazards: Hurricane (Strong Category 4) and a severe flood caused by an extreme precipitation event. For Step 2, climate change effects were applied to the context of threat and hazard scenarios: additional structural stress on infrastructure due to extreme high temperatures event in the earthquake scenario, aggravated flooding due to sea level causing severe impacts and damages to critical infrastructure in the tsunami scenario, higher ocean temperatures causing more powerful storms in the hurricane scenario and severe flooding caused by increased regional downpours and severe precipitation in the flood scenario. The integration of climate change effects and considerations helped build stronger scenarios which at the same time lead to form stronger outcomes, impacts and capability target for Step 3, and also rethink capability estimation for Step 4.

## THIRA Journal Notes

-- No Journal Notes --

# Puerto Rico 2016 SPR

## SPR Capability Ratings

### Planning

Internal Ratings

| Planning | Organization | Equipment | Training | Exercises |
|---|---|---|---|---|
| 3 | 3 | 2 | 2 | 3 |

### Public Information and Warning

Internal Ratings

| Planning | Organization | Equipment | Training | Exercises |
|---|---|---|---|---|
| 4 | 3 | 4 | 5 | 4 |

### Operational Coordination

Internal Ratings

| Planning | Organization | Equipment | Training | Exercises |
|---|---|---|---|---|
| 3 | 2 | 2 | 3 | 3 |

### Forensics and Attribution

Internal Ratings

| Planning | Organization | Equipment | Training | Exercises |
|---|---|---|---|---|
| 3 | 3 | 2 | 2 | 2 |

## Intelligence and Information Sharing

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 1 | 1 | 1 | 1 |

## Interdiction and Disruption

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 1 | 1 | 3 | 1 |

## Screening, Search, and Detection

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 2 | 3 | 2 | 1 |

## Access Control and Identity Verification

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 5 | 5 | N/A | N/A |

## Cybersecurity

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 1 | 1 | 1 | 1 | 1 |

## Physical Protective Measures

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 5 | 5 | 3 | 1 |

## Risk Management for Protection Programs and Activities

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 1 | 1 | 1 | 2 | 1 |

## Supply Chain Integrity and Security

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 3 | 2 | 3 | 2 |

## Community Resilience

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 4 | 3 | 3 | 3 |

## Long-term Vulnerability Reduction

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 3 | 3 | 3 | 3 |

## Risk and Disaster Resilience Assessment

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 3 | 3 | 2 | 2 |

## Critical Transportation

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 4 | 2 | 2 | 4 |

## Environmental Response/Health and Safety

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 2 | 2 | 2 | 3 |

## Fatality Management Services

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 3 | 2 | 3 | 1 |

## Infrastructure Systems

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 3 | 3 | 4 | 2 |

## Mass Care Services

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 2 | 2 | 3 | 1 |

## Mass Search and Rescue Operations

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 3 | 3 | 3 | 3 |

## Operational Communications

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 4 | 4 | 4 | 4 |

## Situational Assessment

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 3 | 3 | 2 | 3 |

## Economic Recovery

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 2 | 2 | 2 | 2 |

## Health and Social Services

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 1 | 2 | 3 | 3 |

## Housing

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 2 | 2 | 3 | 1 |

## Natural and Cultural Resources

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 5 | 5 | 4 | 3 | 1 |

## On-scene Security, Protection, and Law Enforcement

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 4 | 3 | 4 | 2 |

## Threats and Hazards Identification

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |

| | | | | |
|---|---|---|---|---|
| 3 | 2 | 3 | 3 | 2 |

## Fire Management and Suppression

**Internal Ratings**

| Planning | Organization | Equipment | Training | Exercises |
|---|---|---|---|---|
| 3 | 4 | 4 | 2 | 4 |

## Logistics and Supply Chain Management

**Internal Ratings**

| Planning | Organization | Equipment | Training | Exercises |
|---|---|---|---|---|
| 5 | 4 | 2 | 3 | 4 |

## Public Health, Healthcare, and Emergency Medical Services

**Internal Ratings**

| Planning | Organization | Equipment | Training | Exercises |
|---|---|---|---|---|
| 5 | 3 | 3 | 4 | 4 |

# SPR Functional Areas Gaps

**Puerto Rico**

## Planning

### Planning

| | |
|---|---|
| Evaluating and updating plans | checked |
| Integrating different plans | checked |
| Pre-incident planning | checked |
| Strategic planning | checked |
| Whole community involvement and coordination | checked |

### Organization

| | |
|---|---|
| Evaluating and updating plans | checked |
| Integrating different plans | checked |
| Operational planning | checked |
| Pre-incident planning | checked |
| Strategic planning | checked |
| Whole community involvement and coordination | checked |

### Equipment

| | |
|---|---|
| Including individuals with disabilities or access/functional needs | checked |
| Pre-incident planning | checked |
| Strategic planning | checked |

## Training

| | |
|---|---|
| Evaluating and updating plans | checked |
| Incorporating risk analyses | checked |
| Integrating different plans | checked |
| Pre-incident planning | checked |
| Strategic planning | checked |
| Whole community involvement and coordination | checked |

## Exercises

| | |
|---|---|
| Evaluating and updating plans | checked |
| Integrating different plans | checked |
| Pre-incident planning | checked |
| Strategic planning | checked |
| Whole community involvement and coordination | checked |

# Public Information and Warning

## Planning

| | |
|---|---|
| Culturally and linguistically appropriate messaging | checked |

## Organization

| | |
|---|---|
| Alerts and warnings | checked |
| Culturally and linguistically appropriate messaging | checked |

| Equipment | |
|---|---|
| Inclusiveness of the entire public | checked |

| Training | |
|---|---|
| Culturally and linguistically appropriate messaging | checked |

| Exercises | |
|---|---|
| Culturally and linguistically appropriate messaging | checked |
| New communications tools and technologies | not checked |

## Operational Coordination

| Planning | |
|---|---|
| Establishing lines of communication | checked |

| Organization | |
|---|---|
| Ensuring information flow | checked |

| Equipment | |
|---|---|
| Allocating and mobilizing resources | checked |
| Other functional area(s), describe below | not checked |

| Training | |
|---|---|
| Ensuring information flow | checked |

| Exercises | |
|---|---|
| Ensuring unity of effort | checked |

# Forensics and Attribution

## Planning

| | |
|---|---|
| Crime scene preservation and exploitation | checked |
| Forensic analysis | checked |

## Organization

| | |
|---|---|
| Crime scene preservation and exploitation | checked |

## Equipment

| | |
|---|---|
| Digital media and network exploitation | checked |
| Evidence collection | checked |
| Forensic analysis | checked |

## Training

| | |
|---|---|
| Forensic analysis | checked |

## Exercises

| | |
|---|---|
| Forensic analysis | checked |

# Intelligence and Information Sharing

## Planning

| | |
|---|---|
| Monitoring information | checked |

## Organization

| | |
|---|---|
| Exploiting and processing information | checked |
| Feedback and evaluation | checked |
| Monitoring information | checked |

## Equipment

| | |
|---|---|
| Exploiting and processing information | checked |
| Monitoring information | checked |

## Training

| | |
|---|---|
| Analysis of intelligence and information | checked |
| Continuous threat assessment | checked |
| Developing reports and products | checked |
| Establishing intelligence and information requirements | checked |
| Exploiting and processing information | checked |
| Gathering intelligence | checked |
| Monitoring information | checked |
| Safeguarding sensitive information | checked |

## Exercises

| | |
|---|---|
| Analysis of intelligence and information | checked |
| Continuous threat assessment | checked |
| Developing reports and products | checked |

| | |
|---|---|
| Disseminating intelligence and information | checked |
| Establishing intelligence and information requirements | checked |
| Exploiting and processing information | checked |
| Feedback and evaluation | checked |
| Gathering intelligence | checked |
| Monitoring information | checked |
| Safeguarding sensitive information | checked |

## Interdiction and Disruption

### Planning

| | |
|---|---|
| Anti-terrorism operations | checked |
| CBRNE detection | checked |
| Financial disruption | checked |
| Wide-area search and detection | checked |

### Organization

| | |
|---|---|
| Anti-terrorism operations | checked |
| Financial disruption | checked |
| Tracking and targeting terrorists and their weapons | checked |

### Equipment

| | |
|---|---|
| Anti-terrorism operations | checked |

| | |
|---|---|
| Financial disruption | checked |
| Tactical law-enforcement operations | checked |
| Tracking and targeting terrorists and their weapons | checked |
| Wide-area search and detection | checked |

### Training

| | |
|---|---|
| Anti-terrorism operations | checked |

### Exercises

| | |
|---|---|
| Deterrent law enforcement presence | checked |
| Financial disruption | checked |
| Interdicting cargo, conveyances, and persons | checked |
| Tactical law-enforcement operations | checked |
| Tracking and targeting terrorists and their weapons | checked |

## Screening, Search, and Detection

### Planning

| | |
|---|---|
| Laboratory testing | checked |
| Locating terrorists | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |

| Organization | |
|---|---|
| Electronic search | checked |
| Locating terrorists | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |

| Equipment | |
|---|---|
| Electronic search | checked |
| Laboratory testing | checked |
| Locating terrorists | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |

| Training | |
|---|---|
| Laboratory testing | checked |
| Locating terrorists | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |

## Exercises

| | |
|---|---|
| Electronic search | checked |
| Laboratory testing | checked |
| Locating terrorists | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |

# Access Control and Identity Verification

## Planning

| | |
|---|---|
| Controlling physical access | checked |

## Organization

| | |
|---|---|
| Controlling physical access | checked |

## Equipment

| | |
|---|---|
| Controlling physical access | checked |

## Training

| | |
|---|---|
| Controlling physical access | checked |

## Exercises

| | |
|---|---|
| Controlling physical access | checked |

# Cybersecurity

## Planning

| | |
|---|---|
| Controlling electronic access | checked |
| Guidelines, regulations, and standards | checked |
| Sharing threat information | checked |

## Organization

| | |
|---|---|
| Controlling electronic access | checked |

## Equipment

| | |
|---|---|
| Controlling electronic access | checked |
| Detecting malicious activity | checked |
| Sharing threat information | checked |

## Training

| | |
|---|---|
| Controlling electronic access | checked |
| Investigating malicious actors | checked |
| Sharing threat information | checked |

## Exercises

| | |
|---|---|
| Controlling electronic access | checked |
| Detecting malicious activity | checked |
| Technical countermeasures | checked |

## Physical Protective Measures

### Planning

| | |
|---|---|
| Other functional area(s), describe below | checked |

### Organization

| | |
|---|---|
| Other functional area(s), describe below | Checked |

### Equipment

| | |
|---|---|
| Other functional area(s), describe below | checked |

### Training

| | |
|---|---|
| Other functional area(s), describe below | checked |

### Exercises

| | |
|---|---|
| Other functional area(s), describe below | checked |

## Risk Management for Protection Programs and Activities

### Planning

| | |
|---|---|
| Risk management planning | checked |
| Risk assessment | checked |
| Risk management planning | checked |

### Organization

| | |
|---|---|
| Analysis tools | checked |
| Incorporating risk assessments in exercise design | not checked |

| | |
|---|---|
| Risk assessment | checked |
| Risk management planning | checked |

### Equipment

| | |
|---|---|
| Analysis tools | checked |
| Incorporating risk assessments in exercise design | not checked |
| Risk assessment | checked |
| Risk management planning | checked |

### Training

| | |
|---|---|
| Analysis tools | checked |
| Incorporating risk assessments in exercise design | not checked |
| Risk assessment | checked |
| Risk management planning | checked |

### Exercises

| | |
|---|---|
| Analysis tools | checked |
| Incorporating risk assessments in exercise design | not checked |
| Risk assessment | checked |
| Risk management planning | checked |

## Supply Chain Integrity and Security

### Planning

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Implementing countermeasures | checked |

### Organization

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Implementing countermeasures | checked |

### Equipment

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Implementing countermeasures | checked |

### Training

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Implementing countermeasures | checked |

### Exercises

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Implementing countermeasures | checked |

## Community Resilience

### Planning

| | |
|---|---|
| Collaborative planning and decision-making | checked |
| Education and skill building | checked |

| | |
|---|---|
| Partnership building | checked |

## Organization

| | |
|---|---|
| Education and skill building | checked |
| Partnership building | checked |
| Understanding the community | checked |

## Equipment

| | |
|---|---|
| Collaborative planning and decision-making | checked |
| Communication and outreach | checked |
| Education and skill building | checked |

## Training

| | |
|---|---|
| Collaborative planning and decision-making | checked |
| Communication and outreach | checked |
| Education and skill building | checked |

## Exercises

| | |
|---|---|
| Communication and outreach | checked |
| Partnership building | checked |
| Understanding the community | checked |

# Long-term Vulnerability Reduction

## Planning

| | |
|---|---|
| Other functional area(s), describe below | checked |
| Incorporating mitigation measures into construction and development | checked |

## Organization

| | |
|---|---|
| Individual and family preparedness | checked |
| Other functional area(s), describe below | checked |

## Equipment

| | |
|---|---|
| Other functional area(s), describe below | checked |

## Training

| | |
|---|---|
| Other functional area(s), describe below | checked |

## Exercises

| | |
|---|---|
| Individual and family preparedness | checked |
| Other functional area(s), describe below | checked |

# Risk and Disaster Resilience Assessment

## Planning

| | |
|---|---|
| Modeling and analysis | checked |
| Education and training | checked |

### Organization

| | |
|---|---|
| Obtaining and sharing data | checked |
| Education and training | checked |

### Equipment

| | |
|---|---|
| Education and training | checked |

### Training

| | |
|---|---|
| Education and training | checked |

### Exercises

| | |
|---|---|
| Education and training | checked |

## Critical Transportation

### Planning

| | |
|---|---|
| Evacuation | checked |

### Organization

| | |
|---|---|
| Evacuation | checked |

### Equipment

| | |
|---|---|
| Establishing access | checked |

### Training

| | |
|---|---|
| Establishing access | checked |
| Evacuation | checked |

## Exercises

| | |
|---|---|
| Establishing access | checked |
| Evacuation | checked |

# Environmental Response/Health and Safety

## Planning

| | |
|---|---|
| Survivor safety and assistance | checked |

## Organization

| | |
|---|---|
| Survivor safety and assistance | checked |

## Equipment

| | |
|---|---|
| Survivor safety and assistance | checked |

## Training

| | |
|---|---|
| Hazardous material clean-up | checked |
| Health and safety monitoring and assessment | checked |
| Survivor safety and assistance | checked |

## Exercises

| | |
|---|---|
| Survivor safety and assistance | checked |
| Hazardous material clean-up | checked |
| Responder safety | checked |

## Fatality Management Services

### Planning

| | |
|---|---|
| Body recovery | checked |

### Organization

| | |
|---|---|
| Body recovery | checked |
| Victim identification | checked |

### Equipment

| | |
|---|---|
| Victim identification | checked |

### Training

| | |
|---|---|
| Body recovery | checked |
| Victim identification | checked |

### Exercises

| | |
|---|---|
| Body recovery | checked |
| Family reunification | checked |
| Victim identification | checked |

## Infrastructure Systems

### Planning

| | |
|---|---|
| Food production and delivery | checked |

### Organization

| | |
|---|---|
| Public safety facilities | checked |
| Infrastructure site assessments | checked |
| Power restoration | checked |

### Equipment

| | |
|---|---|
| Power restoration | checked |
| Water treatment and provision | checked |
| Dams and flood control | checked |

### Training

| | |
|---|---|
| Infrastructure site assessments | checked |
| Power restoration | checked |
| Water treatment and provision | checked |

### Exercises

| | |
|---|---|
| Infrastructure site assessments | checked |
| Power restoration | checked |

## Mass Care Services

### Planning

| | |
|---|---|
| Family reunification | checked |
| Pets | checked |
| Sheltering | checked |

## Organization

| | |
|---|---|
| Family reunification | checked |
| Pets | not checked |
| Sheltering | checked |
| Other functional area(s), describe below | checked |

## Equipment

| | |
|---|---|
| Family reunification | checked |
| Pets | checked |
| Sheltering | checked |
| Other functional area(s), describe below | checked |

## Training

| | |
|---|---|
| Family reunification | checked |
| Pets | not checked |
| Other functional area(s), describe below | checked |

## Exercises

| | |
|---|---|
| Family reunification | checked |
| Pets | checked |
| Sheltering | checked |
| Other functional area(s), describe below | checked |

# Mass Search and Rescue Operations

## Planning

| | |
|---|---|
| Synchronizing operations | checked |

## Organization

| | |
|---|---|
| Specialized operations | checked |

## Equipment

| | |
|---|---|
| Rescue operations | checked |
| Search operations | checked |
| Specialized operations | checked |

## Training

| | |
|---|---|
| Rescue operations | checked |
| Search operations | checked |
| Specialized operations | checked |

## Exercises

| | |
|---|---|
| Rescue operations | checked |
| Search operations | checked |
| Specialized operations | checked |

## Operational Communications

### Planning

| | |
|---|---|
| Communication between responders and the affected population | checked |

### Organization

| | |
|---|---|
| Communication between responders and the affected population | checked |

### Equipment

| | |
|---|---|
| Interoperable communications between responders | checked |
| Voice communications | checked |

### Training

| | |
|---|---|
| Interoperable communications between responders | checked |

### Exercises

| | |
|---|---|
| Data communications | checked |
| Interoperable communications between responders | checked |

## Situational Assessment

### Exercises

| | |
|---|---|
| Assessing hazard impacts | checked |

### Organization

| | |
|---|---|
| Tracking response activities | checked |

### Equipment

| | |
|---|---|
| Delivering situation reports | checked |

### Training

| | |
|---|---|
| Other functional area(s), describe below | checked |

### Exercises

| | |
|---|---|
| Tracking response activities | checked |

## Economic Recovery

### Planning

| | |
|---|---|
| Developing recovery objectives | checked |
| Economic impact assessments | checked |
| Reopening businesses | checked |

### Organization

| | |
|---|---|
| Developing recovery objectives | checked |
| Reopening businesses | checked |
| Economic impact assessments | checked |

### Equipment

| | |
|---|---|
| Developing recovery objectives | checked |
| Reopening businesses | checked |
| Economic impact assessments | checked |

### Training

| | |
|---|---|
| Developing recovery objectives | checked |
| Economic impact assessments | checked |
| Reopening businesses | checked |

### Exercises

| | |
|---|---|
| Developing recovery objectives | checked |
| Economic impact assessments | checked |
| Reopening businesses | checked |

## Health and Social Services

### Planning

| | |
|---|---|
| Determining health and social needs | checked |

### Organization

| | |
|---|---|
| Determining health and social needs | checked |

### Equipment

| | |
|---|---|
| Determining health and social needs | checked |

### Training

| | |
|---|---|
| Determining health and social needs | checked |

### Exercises

| | |
|---|---|
| Determining health and social needs | checked |

## Housing

### Planning

| | |
|---|---|
| Reconstruction of destroyed housing | checked |

### Organization

| | |
|---|---|
| Housing assessments | checked |

### Equipment

| | |
|---|---|
| Reconstruction of destroyed housing | checked |

### Training

| | |
|---|---|
| Reconstruction of destroyed housing | checked |

### Exercises

| | |
|---|---|
| Rehabilitation of damaged housing | checked |

## Natural and Cultural Resources

### Planning

| | |
|---|---|
| Damage assessment | not checked |
| Environmental preservation and restoration | not checked |
| Other functional area(s), describe below | not checked |

### Organization

| | |
|---|---|
| Damage assessment | not checked |

| | |
|---|---|
| Environmental preservation and restoration | not checked |
| Historic preservation | not checked |

### Equipment

| | |
|---|---|
| Damage assessment | checked |
| Environmental preservation and restoration | checked |

### Training

| | |
|---|---|
| Other functional area(s), describe below | checked |

### Exercises

| | |
|---|---|
| Other functional area(s), describe below | checked |

## On-scene Security, Protection, and Law Enforcement

### Planning

| | |
|---|---|
| Law enforcement | checked |

### Organization

| | |
|---|---|
| Law enforcement | checked |

### Equipment

| | |
|---|---|
| Law enforcement | checked |
| Protecting response personnel | checked |
| Securing disaster areas | checked |

### Training

| | |
|---|---|
| Securing disaster areas | checked |

### Exercises

| | |
|---|---|
| Securing disaster areas | checked |

## Threats and Hazards Identification

### Planning

| | |
|---|---|
| Data collection and sharing | checked |
| Estimating frequency and magnitude | checked |
| Stakeholder collaboration/coordination | checked |

### Organization

| | |
|---|---|
| Data collection and sharing | checked |
| Modeling and analysis | checked |
| Stakeholder collaboration/coordination | checked |

### Equipment

| | |
|---|---|
| Modeling and analysis | checked |
| Stakeholder collaboration/coordination | checked |

### Training

| | |
|---|---|
| Data collection and sharing | checked |
| Modeling and analysis | checked |
| Stakeholder collaboration/coordination | checked |

## Exercises

| | |
|---|---|
| Data collection and sharing | checked |
| Estimating frequency and magnitude | checked |
| Stakeholder collaboration/coordination | checked |

# Fire Management and Suppression

## Planning

| | |
|---|---|
| Structural firefighting | checked |
| Wildland firefighting | checked |
| Specialized firefighting | checked |
| Initial attack firefighting | checked |
| Extended attack firefighting | checked |

## Organization

| | |
|---|---|
| Structural firefighting | checked |
| Wildland firefighting | checked |
| Specialized firefighting | checked |
| Initial attack firefighting | checked |
| Extended attack firefighting | checked |

## Equipment

| | |
|---|---|
| Structural firefighting | checked |
| Wildland firefighting | checked |
| Specialized firefighting | checked |
| Initial attack firefighting | checked |
| Extended attack firefighting | checked |

## Training

| | |
|---|---|
| Structural firefighting | checked |
| Wildland firefighting | checked |
| Specialized firefighting | checked |
| Initial attack firefighting | checked |
| Extended attack firefighting | checked |

## Exercises

| | |
|---|---|
| Structural firefighting | checked |
| Wildland firefighting | checked |
| Specialized firefighting | checked |
| Initial attack firefighting | checked |
| Extended attack firefighting | checked |

# Logistics and Supply Chain Management

## Planning

| | |
|---|---|
| Donation management | checked |
| Resource delivery | checked |
| Resource management | checked |
| Resource tracking | checked |
| Volunteer management | checked |

## Organization

| | |
|---|---|
| Private resources | checked |
| Donation management | checked |
| Resource delivery | checked |
| Emergency power provision | checked |
| Resource management | checked |
| Fuel support | checked |
| Resource tracking | checked |
| Supply chain restoration | checked |
| Volunteer management | checked |

## Equipment

| | |
|---|---|
| Emergency power provision | checked |

| | |
|---|---|
| Fuel support | checked |
| Private resources | checked |
| Resource delivery | not checked |
| Resource management | checked |
| Resource tracking | checked |

## Training

| | |
|---|---|
| Access to community staples | checked |
| Donation management | checked |
| Resource management | checked |
| Volunteer management | checked |

## Exercises

| | |
|---|---|
| Resource tracking | checked |
| Volunteer management | checked |
| Access to community staples | checked |
| Donation management | checked |
| Resource delivery | checked |
| Resource management | checked |

# Public Health, Healthcare, and Emergency Medical Services

## Planning

| | |
|---|---|
| Other functional area(s), describe below | checked |
| Emergency medical services | checked |
| Medical surge | checked |

## Organization

| | |
|---|---|
| Other functional area(s), describe below | checked |

## Equipment

| | |
|---|---|
| Emergency medical services | checked |
| Other functional area(s), describe below | checked |

## Training

| | |
|---|---|
| Emergency medical services | checked |
| Other functional area(s), describe below | checked |

## Exercises

| | |
|---|---|
| Other functional area(s), describe below | checked |

# SPR Capability Gaps

**No Response**

# SPR Capability Recent Advances

**Puerto Rico**

## Access Control and Identity Verification

### Planning

New ID's

## Physical Protective Measures

### Planning

Up Grade Access Control System and ID Calls.

## Fatality Management Services

### Planning

The Forensic Institute Mass Fatality Plan has been completed and is pending signature of the Institute's Director and Secretary of Health signatures.   Jurisdictional Mass Fatality Plan is being updated.

### Training

Fatality Management Capability has been increased with the acquisition of two mobile morgue, one for each of the Municipal Islands of Vieques y Culebra.

# SPR Gap Responsibility

**Puerto Rico**

## Planning

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Public Information and Warning

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Operational Coordination

| Value | Description |
|---|---|
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Forensics and Attribution

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Intelligence and Information Sharing

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Interdiction and Disruption

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Screening, Search, and Detection

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Access Control and Identity Verification

| Value | Description |
|---|---|
| 1 | There is no gap for this capability; sustainment needs only |

## Cybersecurity

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Physical Protective Measures

| Value | Description |
|---|---|
| 2 | The capability target should be attained solely by the jurisdiction; the jurisdiction will continue to increase this capability until the outcome is met |

## Risk Management for Protection Programs and Activities

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Supply Chain Integrity and Security

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Community Resilience

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Long-term Vulnerability Reduction

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Risk and Disaster Resilience Assessment

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Critical Transportation

| Value | Description |
|---|---|
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Environmental Response/Health and Safety

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Fatality Management Services

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Infrastructure Systems

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Mass Care Services

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Mass Search and Rescue Operations

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Operational Communications

| Value | Description |
| --- | --- |
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Situational Assessment

| Value | Description |
| --- | --- |
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Economic Recovery

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Health and Social Services

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Housing

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Natural and Cultural Resources

| Value | Description |
|---|---|
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## On-scene Security, Protection, and Law Enforcement

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Threats and Hazards Identification

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Fire Management and Suppression

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Logistics and Supply Chain Management

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Public Health, Healthcare, and Emergency Medical Services

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

# SPR Capability Priorities

**Puerto Rico**

## High Priority

Housing

Economic Recovery

Infrastructure Systems

Situational Assessment

Public Health, Healthcare, and Emergency Medical Services

Operational Communications

On-scene Security, Protection, and Law Enforcement

Mass Search and Rescue Operations

Mass Care Services

Logistics and Supply Chain Management

Fire Management and Suppression

Fatality Management Services

Environmental Response/Health and Safety

Critical Transportation

Threats and Hazards Identification

Risk and Disaster Resilience Assessment

Long-term Vulnerability Reduction

Community Resilience

Supply Chain Integrity and Security

Physical Protective Measures

Access Control and Identity Verification

Screening, Search, and Detection

Interdiction and Disruption

Intelligence and Information Sharing

Forensics and Attribution

Operational Coordination

Planning

Natural and Cultural Resources

## Medium Priority

Health and Social Services

Risk Management for Protection Programs and Activities

Cybersecurity

Public Information and Warning

# SPR Assessment Corroboration

**Puerto Rico**

## Housing

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Health and Social Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Economic Recovery

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Infrastructure Systems

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | TRUE | FALSE | Strikes and emergency drills (PR Aqueduct and Sewer Authority)<br><br>Tropical Storms, Hurricane Georges, Hugo and Hortense |

## Situational Assessment

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|

| | | | |
|---|---|---|---|
| TRUE | FALSE | FALSE | Caribe Wave/Large Atlantic Tsunami Exercise, Shake Out and emergency exercises in dams. |

## Public Health, Healthcare, and Emergency Medical Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | PR Department of Health Exercises |

## Operational Communications

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Tropical Storm Erika |

## On-scene Security, Protection, and Law Enforcement

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Yearly Hurricane Season |

## Mass Search and Rescue Operations

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Haiti Earthquake 2010, Military Helicopter Crash 2010, Airplane Crash 2013 |

## Mass Care Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Logistics and Supply Chain Management

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | TRUE | FALSE | 2016 CERT training and exercises<br><br>Tropical Storm Erika |

## Fire Management and Suppression

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | 2016 Maritime fire-fighting exercise in Peñuelas, Puerto Rico. |

## Fatality Management Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Environmental Response/Health and Safety

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Critical Transportation

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Hurricanes and Tropical Storms |

## Threats and Hazards Identification

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Risk and Disaster Resilience Assessment

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Long-term Vulnerability Reduction

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Yearly Hurricane Season |

## Community Resilience

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Supply Chain Integrity and Security

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | TRUE | FALSE | 2015 Borinqueneer exercise<br>Tropical Storm Erika |

## Risk Management for Protection Programs and Activities

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Physical Protective Measures

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Cybersecurity

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Access Control and Identity Verification

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Screening, Search, and Detection

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Interdiction and Disruption

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|

| | | | |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Intelligence and Information Sharing

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Forensics and Attribution

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Operational Coordination

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | 2015 Borinqueneer Exercise |

## Public Information and Warning

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | 2016 Tropical Storms, and Floods. |

## Planning

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | TRUE | FALSE | 2015 Borinqueneer exercise<br><br>Annual Hurricane Season |

# Natural and Cultural Resources

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Floods, Search and Rescue Operations, Forest Fire Events. |

# SPR Journal Notes

## Mass Care Services

Answer derived from PR Department of Housing and Health Representatives

## Logistics and Supply Chain Management

During 2016, The Community Emergency Response Team program (CERT) certified 2,886 adults, 563 teenagers and 208 students from elementary schools.

# SPR Post-Assessment Data

**Puerto Rico**

## County

N/A

## Federal

N/A

## Non-Governmental Organizations

### Other VOAD

1

### Private sector / Business

1

## Other (specify)

N/A

## Other City

N/A

## State

### Other: Ports Authority

1

### Emergency Management / Homeland Security

2

### Environment

2

### Fire / EMS

1

### Fusion Center

1

## Law Enforcement / Public Safety

2

## Other: Electric Power

1

## Other: Sewer and Aqueduct Authority

1

## Other: Family/Social Services

1

## Other: General Services

1

## Other: Housing

1

## Other: Telecommunications

1

## Public Health

1

## Transportation

1

## Territory

N/A

## Tribal

N/A

## UASI

N/A

## SPR Post-Assessment Training and Education Course Requirements

**Training and Education Course Requirements:** Collaborative Planning and Decision Making, Cybersecurity, THIRA, Emergency Management.

## SPR Post-Assessment Promising Practices

**Promising Practices:** San Juan Puerto Rico, is the jurisdiction in the United States ho has gained a recognition for collaborating with Federal and local entities in each public safety fields.

## SPR Post-Assessment Capability Most Progress, Danger

### Most Danger

Interdiction and Disruption

Intelligence and Information Sharing

Operational Coordination

### Most Progress

Operational Communications

Community Resilience

Public Information and Warning

## SPR Post-Assessment Senior Advisory Committee

| | |
|---|---|
| **Charter existence:** | Yes |
| **Key Governance Processes:** | checked |
| **SAC composition:** | checked |
| **How existing governance bodies will be leveraged:** | checked |

| | |
|---|---|
| **The frequency at which the SAC will meet:** | checked |
| **How SAC is informed by State's THIRA, SPR data:** | checked |
| **Approach to address gaps in core capabilities:** | checked |
| **How decisions on programmatic priorities funded:** | checked |
| **How decisions on funded priorities will be documented, shared:** | checked |
| **Roles and responsibilities for financial decision making:** | checked |
| **Public distribution?:** | Yes |
| **POC Name:** | Joel J García |
| **POC Email Address:** | jgarcia@oasp.pr.gov |
| **POC Phone Number:** | 787-763-3424 |

# SPR Journal Notes

## Overall Journal Notes

640 Hours

# U.S. Virgin Islands 2016 THIRA

## THIRA Steps 1-2: Threats and Hazards

### Earthquake

**Category:** Natural **Type:** Earthquake **Terrorism:**

**Context Description:**

On a Tuesday afternoon during high season a magnitude 7.1 earthquake occurs in the Anegada trough between St. Croix and St. Thomas. There are 4 cruise ships in port with approximately 7,000 - 9,000 passengers and crew. As a result of the shaking buildings in the Charlotte Amalie area are damaged causing falling debris as well as fires and explosions. Roads throughout the territory are damaged or collapsing.

### Tsunami

**Category:** Natural **Type:** Tsunami **Terrorism:**

**Context Description:**

On a Tuesday afternoon during high season a magnitude 7.1 earthquake occurs in the Anegada trough between St. Croix and St. Thomas. Causing a local tsunami with only minutes for the territory to react. There are 4 cruise ships in the port of St. Thomas with approximately 7,000 - 9,000 passengers and crew. The tsunami generates 40 foot waves that strike the southern portions of St. John and St. Thomas and the Northern portion of St. Croix. The other portions of each island are impacted by smaller tsunami waves.

### Hurricane/Typhoon

**Category:** Natural **Type:** Hurricane / Typhoon **Terrorism:**

**Context Description:**

Late season Category 3 hurricane in October with sustained winds of 127mph makes landfall in the Virgin Islands. Wind gusts approaching 140 mph were estimated from an aerial damage survey conducted soon after the hurricane's passage. Hurricane system leaves damage across the territory affecting government infrastructure, homes and businesses. Communications, water and power generation infrastructure sustained significant damaged. Roadways are damaged or blocked by debris.

## Explosive Devices

**Category:** Human Caused **Type:** Explosive Devices **Terrorism:**

**Context Description:**

On the afternoon of April 26th, an improvised explosive device (IED) was detonated in carnival village killing and wounding a large number of people attending carnival activities. On this day, there are three cruise ships in port with an estimated 5000-7000 passengers ashore. Carnival activities have also brought many people over form St. Croix and St. John to take part in the activities. The explosion causes mass confusion and quickly over loads the territory's ability to respond to large scale emergency events.

## Cyberattack

**Category:** Human Caused **Type:** Cyberattack **Terrorism:**

**Context Description:**

A potential threat exists with domestic and foreign group using strategic cyberattacks to cause mass confusion by stealing personal information from consumers while profiting by selling information to criminal groups and organizations. During the tourism season the US Virgin Islands experiences a surge in population where approximately 15,000 - 20,000 visit. Tourist and family members return to enjoy shopping and beaches. An estimated (Daily) 5,000-7,000 boost in the population to the down town shopping area where hundreds of shoppers expose their personal information using credit cards and cell phones. The influx of people would be expected all throughout the island not just limited to the downtown area. During the season ships will be docked at the Heaven sight and Crown Bay area with a combined mixture of residents and visiting tourist in the US Virgin Islands. The negative impact of a Cyberattack could cause significant cascading effects for the future of tourism in the Virgin Islands.

# THIRA Journal Notes

### Overall Journal Notes

Discuss

# THIRA Step 3: Establish Capability Targets and Impacts and Desired Outcomes

## Planning

**Capability Target:**

PREVENTION: Implement operational prevention plans that dictate the roles and responsibilities and the sequence and scope of tasks needed to prevent an incident across a 134-square mile area with 106,000 residents within 30 minutes of notification of an imminent, credible terrorist threat.

PROTECTION: Review and update protection plans with at least 4 whole community partners, including representatives of individuals with disabilities and those with access and functional needs, every year.

MITIGATION: Every 5 years, update the hazard mitigation plan addressing all the mission areas, with specific annexes as required. Engage whole community partners as appropriate in mitigation planning to meet defined objectives.

RESPONSE: Coordinate with at least 4 territorial agencies year to insure they have current EOPs and COOP plans in place. Support at least 4 territorial agencies and NGOs in reviewing and updating their respective EOP each year. Engage at least 4 whole community partners each year on response planning I support of Territorial objectives. Revise and update the USVI Territorial Emergency Operations Plan by the 11/30/16.RECOVERY: Evaluate, update, and maintain a COOP plan every 5 years for all territorial agencies. Engage whole community partners as appropriate in recovery planning to meet defined objectives.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 4 islands and 160,000 total residents. Whole community partners, including representatives of individuals with disabilities and those with access and functional needs. Mitigation Impacts5 Year-cycle to develop/update physical hazard mitigation plans Recovery Impacts5 Days within incident to execute recovery plan.5 Year-cycle to update government COOP plans. | Update hazard mitigation plans every 5 years in accordance with federal and territorial requirements.<br><br>Implement Recovery Plans that identify specific tasks to conduct recovery operations within five days of incident |
| Tsunami | 4 islands and 160,000 total residents. Whole community partners, including representatives of individuals with disabilities and those with access and functional needs. Mitigation Impacts5 Year-cycle to develop/update physical hazard mitigation plans Recovery Impacts5 Days within incident to execute recovery plan.5 Year-cycle to update government COOP plans. | Update hazard mitigation plans every 5 years in accordance with federal and territorial requirements.<br><br>Implement Recovery Plans that identify specific tasks to conduct recovery operations within five days of incident |

| | | |
|---|---|---|
| Hurricane/ Typhoon | 4 islands and 160,000 total residents. Whole community partners, including representatives of individuals with disabilities and those with access and functional needs. Mitigation Impacts5 Year-cycle to develop/update physical hazard mitigation plans Recovery Impacts5 Days within incident to execute recovery plan.5 Year-cycle to update government COOP plans. | Update hazard mitigation plans every 5 years in accordance with federal and territorial requirements.<br><br>Implement Recovery Plans that identify specific tasks to conduct recovery operations within five days of incident |
| Explosive Devices | During the first 72 hours, transportation infrastructure along with 45 percent of the population (to include tourist and visitors) will be impacted by the event. 30 percent of emergency staff will be unable to function due to injuries, deaths, chaos and disruptions with the affected area. | Conduct a systematic process engaging the whole community as appropriate in the development of executable strategic, operational, and/or tactical-level approaches to meet defined objectives. |
| Cyberattack | N/A | Conduct a systematic process engaging the whole community as appropriate in the development of executable strategic, operational, and/or tactical-level approaches to meet defined objectives. |

## Public Information and Warning

**Capability Target:** Prevention Capability Target: Within 10 (ten) minutes, and using a variety of delivery systems, share all actionable messages, to include NTAS alerts, with 100 percent of the public and other stakeholders, as appropriate, to aid in the prevention of imminent or follow-on terrorist attacks, consistent with the timeline specified by existing processes and protocols. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media,

coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring warnings and information reach individuals with access and functional needs or limited English proficiency.

Protection Capability Target: Operate effective and accessible indication and warning systems to communicate significant threats and hazards to all 106,000 residents, including involved operators, security officials, and the public (including alerts, detection capabilities, and other necessary and appropriate assets), within one hour of a potential or actual threat/hazard. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring warnings and information reach individuals with access and functional needs or limited English proficiency.

Mitigation Capability Target: Provide 106,000 residents with useful and relevant information on the threats and hazards faced by the community and how to prepare for them. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring warnings and information reach individuals with access and functional needs or limited English proficiency.

Response Capability Target: Within one (1) hour of a declared emergency or disaster, inform 106,000 people within the affected area necessary, including accessible tools, of critical lifesaving, life-sustaining, and actionable information to expedite the delivery of emergency services and aid the public in taking protective actions. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring information reaches individuals with access and functional needs or limited English proficiency.

| | | |
|---|---|---|
| | Recovery Capability Target: Within six (6) hour after the threat of an emergency or disaster event has passed, the Joint Information Center reaches 106,000 people within the affected area with actionable, recovery-related public information. Deliver public information in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring information reaches individuals with access and functional needs or limited English proficiency. | |

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Prevention Impacts Ability to share actionable messages within 10 minutes of a incident5 Methods in place to deliver public information in appropriate and effective ways Protection Impacts106,000 Residents to reach with warning systems5 Methods in place to deliver public information in appropriate and effective ways Mitigation Impacts106,000 Residents to reach with useful and relevant mitigation information5 Methods in place to deliver public information and warning in appropriate and effective ways Response Impacts Ability to deliver actionable public information and warning to the public within 1 hour 106,000 residents to inform within the affected area5000-8000 tourists to inform within the affected area5 Methods in place to deliver public information in appropriate and effective ways Recovery Impacts Ability to provide | Deliver coordinated, prompt, reliable, and actionable information to the whole community using clear, consistent, accessible, and culturally and linguistically appropriate methods to effectively relay information regarding any threat or hazard, as well as the actions being taken and the assistance being made available, as appropriate. |

| | | |
|---|---|---|
| | actionable recovery-related information in appropriate and effective ways to the public within 6 hours106,000 People to inform within the affected area5 Methods in place to deliver public information in appropriate and effective ways | |
| Tsunami | Prevention Impacts Ability to share actionable messages within 10 minutes of a incident5 Methods in place to deliver public information in appropriate and effective ways Protection Impacts106,000 Residents to reach with warning systems5 Methods in place to deliver public information in appropriate and effective ways Mitigation Impacts106,000 Residents to reach with useful and relevant mitigation information5 Methods in place to deliver public information and warning in appropriate and effective ways Response Impacts Ability to deliver actionable public information and warning to the public within 1 hour 106,000 residents to inform within the affected area5000-8000 tourists to inform within the affected area5 Methods in place to deliver public information in appropriate and effective ways Recovery Impacts Ability to provide actionable recovery-related information in appropriate and effective ways to the public within 6 hours106,000 People to inform within the affected area5 Methods | Deliver coordinated, prompt, reliable, and actionable information to the whole community using clear, consistent, accessible, and culturally and linguistically appropriate methods to effectively relay information regarding any threat or hazard, as well as the actions being taken and the assistance being made available, as appropriate. |

| | | |
|---|---|---|
| | in place to deliver public information in appropriate and effective ways | |
| Hurricane/ Typhoon | Protection Impacts106,000 Residents to reach with warning systems5 Methods in place to deliver public information in appropriate and effective ways Mitigation Impacts106,000 Residents to reach with useful and relevant mitigation information5 Methods in place to deliver public information and warning in appropriate and effective ways Response Impacts Ability to deliver actionable public information and warning to the public within 1 hour 106,000 People to inform within the affected area5 Methods in place to deliver public information in appropriate and effective ways Recovery Impacts Ability to provide actionable recovery-related information in appropriate and effective ways to the public within 6 hours106,000 People to inform within the affected area5 Methods in place to deliver public information in appropriate and effective ways | Deliver coordinated, prompt, reliable, and actionable information to the whole community using clear, consistent, accessible, and culturally and linguistically appropriate methods to effectively relay information regarding any threat or hazard, as well as the actions being taken and the assistance being made available, as appropriate. |
| Explosive Devices | Prevention Impacts Ability to share actionable messages within 10 minutes of a incident5 Methods in place to deliver public information in appropriate and effective ways Protection Impacts6,000 Residents to reach with warning systems5 Methods in place to deliver public | Deliver coordinated, prompt, reliable, and actionable information to the whole community using clear, consistent, accessible, and culturally and linguistically appropriate methods to effectively relay information regarding any threat or hazard, as well as the actions being taken and the assistance being made available, as |

| | | |
|---|---|---|
| | information in appropriate and effective ways Response Impacts Ability to deliver actionable public information and warning to the public within 1 hour 6,000 People to inform within the affected area5 Methods in place to deliver public information in appropriate and effective ways Recovery Impacts Ability to provide actionable recovery-related information in appropriate and effective ways to the public within 6 hours6,000 People to inform within the affected area5 Methods in place to deliver public information in appropriate and effective ways | appropriate. |
| Cyberattack | N/A | N/A |

## Operational Coordination

**Capability Target:** PREVENTION: Establish unified command structures to coordinate prevention activities with law enforcement/responders within 30 minutes of notification of a credible threat.

PROTECTION: Conduct an audit every 6 months to ensure all Emergency Operation Center personnel have completed Incident Command Systems training (or equivalent training) and all Emergency Operation Center supervisory personnel have completed Multiagency Coordination Systems training (or equivalent training).

MITIGATION: Collaborate with whole community partners on mitigations projects every 3 years.

RESPONSE: Coordinate with territorial agencies, federal partners, non-governmental and private sector partners to provide emergency support services to 106,000 residents across 4 islands within 3 days of an incident.

RECOVERY: Establish a process for acquiring funding and assistance from Federal and Territorial entities, as well as non-governmental and private sector partners to support the recovery of 106,000 residents across 4 islands within 3 days of an incident.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 134 Square miles and 106,000 residents | Establish and maintain a unified and coordinated operational structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities. |
| Tsunami | 134 Square miles and 106,000 residents. | Establish and maintain a unified and coordinated operational structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities. |
| Hurricane/ Typhoon | 134 square miles and 106,000 residents. | Establish and maintain a unified and coordinated operational structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities. |
| Explosive Devices | 20,000 residents and tourists in a 1 square mile area. | Establish and maintain a unified and coordinated operational structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities. |
| Cyberattack | 5000-7000 tourists in the downtown Charlotte Amalie area and another 10000-15000 tourists across St. Thomas. Hundreds of businesses across St. Thomas. | Establish and maintain a unified and coordinated operational structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities. |

## Forensics and Attribution

**Capability Target:** Conduct site exploitation for evidence, physical evidence analysis, biometric and DNA analysis, and digital media and network exploitation in the first 48 hours of a complex event, with the goal of preventing a follow-on attack. Prioritize, collect, and examine 85 percent of evidence associated with an act of terrorism or an imminent terrorist attack and all critical infrastructure sectors. Identify 100 percent of the terrorist actors, co-conspirators, and their sponsors by fusing all science-based forensic results and all source intelligence information and products across all critical infrastructure sectors. In coordination with Federal partners, prioritize the collection and processing of debris, plus 75 percent of all trace, digital, and/or biometric evidence, within 72 hours of an attack to identify the perpetrator(s) and prevent future attacks.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | N/A | N/A |
| Explosive Devices | 24 Hours within incident to conduct site exploitation 85 percent of evidence to prioritize collect and examine 85 percent CI sectors affected 100 percent Capacity to prioritize evidence 100 percent People affected Within 72 hours tons of debris to collect and prioritize24 Hours within incident to identify perpetrators and prevent future attacks | Conduct forensic analysis and attribute terrorist acts (including the means and methods of terrorism) to their source, to include forensic analysis as well as attribution for an attack and for the preparation for an attack in an effort to prevent initial or follow-on acts and/or swiftly develop counter-options. |
| Cyberattack | 24 Hours within incident to conduct | Conduct forensic analysis and attribute |

site exploitation 85 percent of evidence to prioritize collect and examine 85 percent CI sectors affected 100 percent Capacity to prioritize evidence 100 percent People affected. Within 72 hours tons of debris to collect and prioritize 24 Hours within incident to identify perpetrators and prevent future attacks

terrorist acts (including the means and methods of terrorism) to their source, to include forensic analysis as well as attribution for an attack and for the preparation for an attack in an effort to prevent initial or follow-on acts and/or swiftly develop counter-options.

## Intelligence and Information Sharing

**Capability Target:**

PREVENTION Capability Target: Within 24 hours of receiving actionable intelligence, develop actionable products and disseminate the information to all federal, state, local, territorial, private sector, and international partners. In the immediate aftermath of an incident, develop real time analysis products every 3 hours. Within 24 hours of an incident, answer requests for information (RFI's) and analyze all suspicious activity reports and other intelligence information to provide intelligence products to all first responder communities and decision makers to assist in operational requirements.

PROTECTION Capability Target: Within 24 hours of receiving intelligence from law enforcement, first responders, and emergency call centers, disseminate actionable intelligence and information to key stakeholders from all government agencies and/or private sector organizations. Within 72, develop information and intelligence gathering priorities in response to a dynamic threat scenario with a potential for follow-on attacks and ensure identification and tasking of all available intelligence assets to support these priorities.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | N/A | N/A |
| Explosive Devices | 10 CIKR facilities to provide intelligence to (WICO, Tropical Shipping, Crowley Shipping, Crown Bay Marina, STT Airport, STX Airport, RLSH, JFLH, Innovative, WAPA)2 Territorial law enforcement agencies to provide intelligence to (VI PD, VIPA PD)4 Federal law enforcement agencies to provide intelligence to (FBI, CBP, USCG, DHS)134 Square miles | Provide timely, accurate, and actionable information resulting from the planning, direction, collection, exploitation, processing, analysis, production, dissemination, evaluation, and feedback of available information concerning threats to the United States, its people, property, or interests; the development, proliferation, or use of WMDs; or any other matter bearing on U.S. national or homeland security by Federal, state, local, and other stakeholders. Information sharing is the ability to exchange intelligence, information, data, or knowledge among Federal, state, local, or private sector entities, as appropriate. |
| Cyberattack | 10 CIKR facilities to provide intelligence to (WICO, Tropical Shipping, Crowley Shipping, Crown Bay Marina, STT Airport, STX Airport, RLSH, JFLH, Innovative, WAPA)2 Territorial law enforcement agencies to provide intelligence to (VI PD, VIPA PD)4 Federal law enforcement agencies to provide intelligence to (FBI, CBP, USCG, DHS)134 Square miles | Provide timely, accurate, and actionable information resulting from the planning, direction, collection, exploitation, processing, analysis, production, dissemination, evaluation, and feedback of available information concerning threats to the United States, its people, property, or interests; the development, proliferation, or use of WMDs; or any other matter bearing on U.S. national or homeland security by Federal, state, local, and other stakeholders. Information sharing is the ability to exchange intelligence, information, data, or knowledge among Federal, state, local, or private sector entities, as appropriate. |

## Interdiction and Disruption

**Capability Target:**

PREVENTION: Support tactical counterterrorism operations across a 134-square mile area within 12 hours of notification of a credible threat. Within 72 hours of their discovery, conduct operations to render safe and dispose of CBRNE hazards in all affected locations simultaneously over a 32-square mile area. Within 2 hours of their detection, interdict conveyances, cargo, or persons associated with an imminent threat to all airports and seaport facilities. Conduct multiple simultaneous tactical counterterrorism operations in up to two separate locations on consecutive days and in all environments. Locate, apprehend, transport, and hold 100 percent of the migrant border crossers per day moving throughout the international border area. Deploy specialized tactical alert teams, bomb squads, or EOD units within 24 hours to prevent initial or follow-on terrorist attacks.

PROTECTION: Establish and continually update procedures and protocols for securing Carnival village within 30 minutes of identifying a threat or hazard. Increase the visible presence of law enforcement by 50 percent to deter or disrupt threats from reaching potential targets such as major public gatherings, and transportation hubs. Ensure the interdiction of 100 percent of all conveyances, cargo, and persons associated with any human-caused threat or act to prevent an incident from occurring or eliminate the risk of a future acts to an area covering the Virgin Islands territories.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | N/A | N/A |

| | | |
|---|---|---|
| Explosive Devices | 134 Square mile impact area Within 48 hours to render safe and dispose of CBRNE hazards. Within 24 hours, request to conduct counter terrorism operations and teams to begin evidence collection and information search for leads to follow. 24 Hours within to deploy teams to prevent further attacks50 percent increase in law enforcement visibility at major public events, gatherings, places50 percent interdiction of all conveyances, cargo and persons associated with threat. Protect 10 square mile surrounding impact area to prevent or eliminate incidents or risk of future acts100 percent CI Lifeline Sector assets prioritized and alerted to increase security postures | Assist federal authorities to Delay, divert, intercept, halt, apprehend, or secure threats and/or hazards. Support tactical counterterrorism operations within 12 hours of notification of a credible threat. |
| Cyberattack | 134 Square mile impact area | Assist federal authorities to Delay, divert, intercept, halt, apprehend, or secure threats and/or hazards. Support tactical counterterrorism operations within 12 hours of notification of a credible threat. |

## Screening, Search, and Detection

**Capability Target:** PROTECTION: Work with federal agencies to screen 100 percent of areas used by employees, travelers, mail, cargo and conveyances using technical, non-technical, intrusive and non-intrusive means without hampering the flow of legitimate commerce. Work with federal agencies to screen 100 percent of targeted conveyances, cargo, and persons associated with illegal activities and criminal

intent, whose actions may pose as an imminent terrorist threat using all means possible. Implement the "See something Say Something" campaign to reach 106,000 residents across 4 islands and 134 Square miles. Work with federal agencies to locate persons and criminal/terrorist networks associated with a potential threat.

PREVENTION Capability Target: Work with federal agencies to conduct 100 percent of CBRNE search/detection operations in all locations and in all environments, consistent with established protocols. Work with federal agencies to screen all people and shipping vessels to identify 100 percent of imminent terrorist threats using technical, non-technical, intrusive, or non-intrusive means, consistent with established protocols. Work with federal agencies to screen 100 percent of patrons, vendors, and employees associated with a mass gathering or special event when there is intelligence or information to indicate the event may be the target of a terrorist attack. Support federal agencies in screening and detecting 100 percent of foodborne, agricultural, and biological threats.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | N/A | N/A |
| Explosive Devices | 2 Cruise ship ports2 International airports3 Carnival/Festivals (STT, STX, STJ)2 Territorial Supreme Court Buildings2 Territorial Superior Court Buildings2 Territorial Legislative Buildings | Work with federal agencies to identify, discover, or locate threats and/or hazards through active and passive surveillance and search procedures. This may include the use of systematic examinations and assessments, sensor technologies, or physical investigation and intelligence. |
| Cyberattack | 2 Cruise ship ports2 International | Work with federal agencies to identify, |

| | | |
|---|---|---|
| | airports3 Carnival/Festivals (STT, STX, STJ)2 Territorial Supreme Court Buildings2 Territorial Superior Court Buildings2 Territorial Legislative Buildings | discover, or locate threats and/or hazards through active and passive surveillance and search procedures. This may include the use of systematic examinations and assessments, sensor technologies, or physical investigation and intelligence. |

## Access Control and Identity Verification

**Capability Target:** Verify access rights to 100 percent of vendors and staff of all priority critical infrastructure and key resources locations and key government facilities to grant or deny access to specific locations or information. Using physical and technological means, establish access control and identity verification for 100 percent of all law enforcement, response, and emergency management personnel at multiple sites and EOCs and ensure rapid and effective credentialing before, during, or after an incident. Verify and control access through physical, technological, and cyber measures for 100 percent of all personnel to critical locations and systems, limiting access to individuals authorized to carry out legitimate activities in the affected areas. Ensure that 100 percent of all vendors, employees, and drivers display valid credentials authorizing them access to critical locations.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | N/A | N/A |
| Explosive Devices | 2 CIKR locations and facilities to protect 1 Square mile impact area | Apply a broad range of physical, technological, and cyber measures to control |

| | | |
|---|---|---|
| | for access control and identify verification measures | admittance to critical locations and systems, limiting access to authorized individuals to carry out legitimate activities. |
| Cyberattack | 100 percent identity verification / access right for personnel | Apply a broad range of physical, technological, and cyber measures to control admittance to critical locations and systems, limiting access to authorized individuals to carry out legitimate activities. |

## Cybersecurity

**Capability Target:** Within two years formalize partnerships with governmental and private sector cyber incident or emergency response teams to accept, triage, and collaboratively respond to incidents in an efficient manner. Within two years formalize partnerships between communities and disciplines responsible for cyber security and physical systems dependent on cyber security. Within two years formalize relationships between information communications technology and information system vendors and their customers for ongoing product cyber security, business planning, and transition to response and recovery when necessary.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | N/A | N/A |
| Explosive Devices | N/A | N/A |

| | | |
|---|---|---|
| Cyberattack | Businesses supporting the territory's tourist industry Territorial agencies processing financial and personal information106,000 Residents on 4 islands | Protect against damage to, the unauthorized use of, and/or the exploitation of (and, if needed, the restoration of) electronic communications systems and services (and the information contained therein). |

## Physical Protective Measures

**Capability Target:** Implement and maintain risk informed physical protection, countermeasures, and policies protecting 100 percent people, critical infrastructure and key resources, borders, and systems associated with key operational activities and critical infrastructure sectors. Implement and maintain risk-informed physical protections, countermeasures, and policies, protecting all public sector critical infrastructure and key resources facilities, 100 percent jurisdiction-operated internet systems, and those materials, products, and systems associated with critical infrastructure sectors and other key operational activities. Encourage 100 percent private sector critical infrastructure and key resources owners and operators to do likewise. Harden physical protective measures for 100 percent high priority critical infrastructure and key resources assets with moderate to very high vulnerability to natural and technological hazards and manmade intentional threats.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | N/A | N/A |
| Explosive | 11 CIKR facilities (WICO, Tropical | Reduce or mitigate risks, including actions |

| | | |
|---|---|---|
| Devices | Shipping, Crowley Shipping, Crown Bay Marina, STT Airport, STX Airport, RLSH, JFLH, Innovative, WAPA, Total Petroleum)134 Square miles across 4 islands | targeted at threats, vulnerabilities, and/or consequences, by controlling movement and protecting borders, critical infrastructure, and the homeland. |
| Cyberattack | I11 CIKR facilities (WICO, Tropical Shipping, Crowley Shipping, Crown Bay Marina, STT Airport, STX Airport, RLSH, JFLH, Innovative, WAPA, Total Petroleum)134 Square miles across 4 islands | Reduce or mitigate risks, including actions targeted at threats, vulnerabilities, and/or consequences, by controlling movement and protecting borders, critical infrastructure, and the homeland. |

## Risk Management for Protection Programs and Activities

**Capability Target:** Every 5 years, complete and maintain updated risk assessments for all recognized high-priority critical infrastructure and key resources (such as Water and Power Authority, all enter and exit Cargo and Commercial ports, Hospital, etc.) and communicate using outreach to potential target assets (Private owned companies and businesses) in the territory. Assemble risk assessments to recognize and prioritize protection actions that can be implemented for 2 hospitals that require protective measures. Every 3 years, update risk assessments for government facilities, critical infrastructure and key resources, and whole community assets (e.g., residential, neighborhoods, community facilities). Build the capability within communities to analyze and assess risk and resilience for 106,000 residents on four islands.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | N/A | N/A |
| Tsunami | N/A | N/A |

| | | |
|---|---|---|
| Hurricane/ Typhoon | N/A | N/A |
| Explosive Devices | 2 Hospitals that require risk assessments and protective measures 1 police station, legislative building, court house that requires risk assessment and protective measures.134 Square-mile region to address with updating risk assessments | Develop and maintain accurate and comprehensive risk assessments. Territorial agencies and federal partners can share data on threats to establish a common operational picture across the mission areas and standardized information being recorded. Share collected data with Federal partners in a timely manner to ensure situational awareness before the integration of man power and resources are deployed for disaster. |
| Cyberattack | 2 Hospitals that require risk assessments and protective measures. Police stations in each district. Legislative buildings in each district. Territorial court buildings in each district. Department of Finance facilities. Internal Revenue Bureau facilities. Department of Property and Procurement facilities134 Square-mile region to address with updating risk assessments | Develop and maintain accurate and comprehensive risk assessments. Territorial agencies and federal partners can share data on threats to establish a common operational picture across the mission areas and standardized information being recorded. Share collected data with Federal partners in a timely manner to ensure situational awareness before the integration of man power and resources are deployed for disaster. |

## Supply Chain Integrity and Security

**Capability Target:** Ensure protocols are in place to increase security and law enforcement support at major supply chain nodes, Logistics Staging Areas (LSAs), and/or Points of Distribution (PODs) across 4 islands within 12 hours of notification of a credible threat or hazard.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Logistics Staging Areas (LSAs), and/or Points of Distribution (PODs) across 4 islands | Ensure protocols are in place to increase security and law enforcement at major supply chain nodes and equivalent areas within 12 hours of notification of a credible threat or hazard. |
| Tsunami | N/A | N/A |
| Hurricane/ Typhoon | Logistics Staging Areas (LSAs), and/or Points of Distribution (PODs) across 4 islands. | Ensure protocols are in place to increase security and law enforcement at major supply chain nodes and equivalent areas within 12 hours of notification of a credible threat or hazard. |
| Explosive Devices | | |
| Cyberattack | Logistics Staging Areas (LSAs), and/or Points of Distribution (PODs) across 4 islands | Ensure protocols are in place to increase security and law enforcement at major supply chain nodes and equivalent areas within 12 hours of notification of a credible threat or hazard. |

## Community Resilience

**Capability Target:** Ensure that 106,000 people in the impacted area are supported by a risk-informed, risk-conscious, mitigation process designed to improve resilience at every level through community leadership, collaboration, partnership building, education, and skill building. Using various communication means, incorporate the message that “physical/virtual security is a shared responsibility" between sectors and between governments and citizens that results in preparing 106,000 people for self-reliance during events using instruction on sustainable protective

measures that could be implemented. Ensure 106,000 individuals in the affected area are educated regarding measures to be taken to safeguard their homes and businesses. Conduct at least 12 outreach events each year to business and community groups, and during community events to enable the recognition, understanding, communication of, and planning for risk and empower individuals and communities to make informed risk management decisions necessary to adapt to, withstand, and quickly recover from future incidents.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 106,000 People in impacted area to support with risk-informed mitigation plans106,000 People to educate on measures to safeguard homes and businesses40 All Hazard sirens | Lead the integrated effort to recognize, understand, communicate, plan, and address risks so that the territory can develop a set of actions to accomplish Mitigation and improve resilience. |
| Tsunami | 106,000 People in impacted area to support with risk-informed mitigation plans106,000 People to educate on measures to safeguard homes and businesses40 All Hazard sirens | Lead the integrated effort to recognize, understand, communicate, plan, and address risks so that the territory can develop a set of actions to accomplish Mitigation and improve resilience. |
| Hurricane/ Typhoon | 106,000 People in impacted area to support with risk-informed mitigation plans106,000 People to educate on measures to safeguard homes and businesses40 All Hazard sirens | Lead the integrated effort to recognize, understand, communicate, plan, and address risks so that the territory can develop a set of actions to accomplish Mitigation and improve resilience. |
| Explosive Devices | N/A | N/A |
| Cyberattack | N/A | N/A |

## Long-term Vulnerability Reduction

**Capability Target:** Complete approved and funded vulnerability reduction projects listed in the 2014 Hazard Mitigation Plan within the grant period of performance. Complete at least 2 mitigation training courses for territorial agencies, businesses, and the public to improve mitigation awareness

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 7 vulnerability reduction projects listed in 2016 Hazard Mitigation Project Priority list. | Complete approved vulnerability reduction projects within 1 year. |
| Tsunami | 7 vulnerability reduction projects listed in 2016 Hazard Mitigation Project Priority list | Complete approved vulnerability reduction projects within 1 year. |
| Explosive Devices | N/A | N/A |
| Hurricane/ Typhoon | 7 vulnerability reduction projects listed in 2016 Hazard Mitigation Project Priority list. | Complete approved vulnerability reduction projects within 1 year. |
| Cyberattack | Impacts of adverse incidents overtime will result in US Virgin Islands being identified as an easy target, exposing vulnerabilities. Additional training and outreach will be requested. Funding for threat and hazard specific training for first responders and public outreach for the private sector community. Support from federal counter parts will be needed to ensure maximum use of training and resources to reduce long term vulnerabilities. | MITIGATION: Reduce 100 percent of consequences and impacts of adverse incidents over time through long term risk-based mitigation to infrastructures, roadways and/or outreach programs to update/inform residents and visitors while providing a safer environment for the estimated population of 110,000 residents (St. Thomas, St. John and St. Croix combined) and approximately 7,000 visitors daily via cruise lines and persons on vacation. Build and sustain resilient communities, and critical infrastructure and key resources lifelines to reduce their vulnerability to natural, technological, and |

human-caused incidents while lessening the likelihood, severity, and duration of the adverse consequences related to these incidents.

## Risk and Disaster Resilience Assessment

**Capability Target:** Complete a risk and disaster resilience assessment to analyze vulnerabilities, resilience capabilities, and estimate impacts of threats and hazards across 4 islands with 106,000 residents every 3 years in accordance with federal and territorial requirements.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 134 square miles, 4 islands, and 106,000 residents | Complete an assessment every 3 years in accordance with federal, state, and local requirements. |
| Tsunami | 134 square miles, 4 islands, and 106,000 residents. | Complete an assessment every 3 years in accordance with federal, state, and local requirements. |
| Hurricane/ Typhoon | 134 square miles, 4 islands, and 106,000 residents. | Complete an assessment every 3 years in accordance with federal, state, and local requirements. |
| Explosive Devices | | |
| Cyberattack | 134 square miles, 4 islands, and 106,000 residents. | Complete an assessment every 3 years in accordance with federal, state, and local requirements. |

## Critical Transportation

**Capability Target:** Clear 150 tons of debris on roadways in a 20-square mile area within 7 days of an incident. Open key ports on St. Thomas, St. John, and St. Croix limited operations within 3 days of an incident while recovery operations continue to bring the facilities back to a fully operational status. Airports on St. Thomas and St. Croix are reopened for limited operations within 3 days while recovery operations continue to bring the facilities back to a fully operational status.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Debris on roadways across a 134-square mile area on three islands. Key ports on St. Thomas, St. John, and St. Croix are closed by the USCG San Juan Sector Captain of the Port. Airports on St. Thomas and St. Croix are closed due to damage or debris. | Clear debris from impacted roadways within 7 days of an incident. Work with USCG to open key ports on St. Thomas, St. John, and St. Croix. Airports on St. Thomas and St. Croix are reopened for limited operations within 3 days while recovery operations continue to bring the facilities back to a fully operational status. |
| Tsunami | Debris on roadways across a 134-square mile area on three islands. Key ports on St. Thomas, St. John, and St. Croix are closed by the USCG San Juan Sector Captain of the Port. Airports on St. Thomas and St. Croix are closed due to damage or debris. | Clear debris from impacted roadways within 7 days of an incident. Work with USCG to open key ports on St. Thomas, St. John, and St. Croix. Airports on St. Thomas and St. Croix are reopened for limited operations within 3 days while recovery operations continue to bring the facilities back to a fully operational status. |
| Hurricane/ Typhoon | Debris on roadways across a 134-square mile area on three islands. Key ports on St. Thomas, St. John, and St. Croix are closed by the USCG San Juan Sector Captain of the Port. Airports on St. Thomas and St. Croix are closed due to damage or debris. | Clear debris from impacted roadways within 7 days of an incident. Work with USCG to open key ports on St. Thomas, St. John, and St. Croix. Airports on St. Thomas and St. Croix are reopened for limited operations within 3 days while recovery operations continue to bring the facilities back to a fully operational status. |

| | | |
|---|---|---|
| Explosive Devices | Transportation services to become disrupted. Infrastructure (roads, marine port, etc.) in the immediate area of incident will be damaged and inoperable. Transportation efforts will be prioritized for life sustaining and lifesaving efforts. Tourist populations on all islands will require immediate evacuation. | During the incident, establish physical access through appropriate transportation corridors and deliver required resources to save lives and to meet the needs of disaster survivors. |
| Cyberattack | N/A | N/A |

## Environmental Response/Health and Safety

**Capability Target:** Within 24 hours, conduct health and safety hazard assessments and disseminate guidance and resources, to include deploying hazardous materials teams to support environmental health and safety action for response personnel and the affected population. Minimize public exposure to environmental hazards for 106,000 people within the 134-square mile affected area.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 106,000 People affected or needing assistance within impact area106,000 People to inform of specific protective measures to take during and following an incident | Conduct appropriate measures to ensure the protection of the health and safety of the public and workers, as well as the environment, from all-hazards in support of responder operations and the affected communities. |
| Tsunami | 106,000 People affected or needing assistance within impact area106,000 People to inform of specific protective measures to take during and following an incident. | Conduct appropriate measures to ensure the protection of the health and safety of the public and workers, as well as the environment, from all-hazards in support of responder operations and the affected communities. |

| | | |
|---|---|---|
| Hurricane/ Typhoon | 106,000 People affected or needing assistance within impact area106,000 People to inform of specific protective measures to take during and following an incident. | Conduct appropriate measures to ensure the protection of the health and safety of the public and workers, as well as the environment, from all-hazards in support of responder operations and the affected communities. |
| Cyberattack | N/A | N/A |
| Explosive Devices | 106,000 People affected or needing assistance within impact area106,000 People to inform of specific protective measures to take during and following an incident. | Conduct appropriate measures to ensure the protection of the health and safety of the public and workers, as well as the environment, from all-hazards in support of responder operations and the affected communities. |

## Fatality Management Services

**Capability Target:** Within 24 hours of a mass-fatality incident, work with appropriate authorities to establish and maintain operations to recover, identify, document, and establish temporary storage or permanent internment solutions the remains of 2000 fatalities over a 134-square mile area.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Availability of staffing, resources and proper equipment will be impacted due to major damage to roadways infrastructure, transportation, and buildings. Delay in response from emergency personnel due to injury, property damage, loss of life, and debris on roads.24 Hours after the incident to establish mass-fatality | Within the first 24 hours: Provide fatality management services, including body recovery and victim identification, working with territorial and federal agencies to provide temporary mortuary solutions, sharing information with mass care services for reunifying family members and caregivers with missing persons/remains, and providing counseling to the bereaved. |

| | | |
|---|---|---|
| | operations.134 Square mile impact area.2000 Fatalities to collect. | |
| Tsunami | Availability of staffing, resources and proper equipment will be impacted due to major damage to roadways infrastructure, transportation, and buildings. Delay in response from emergency personnel due to injury, property damage, loss of life, and debris on roads.24 Hours after the incident to establish mass-fatality operations.134 Square mile impact area.2000 Fatalities to collect. | Within the first 24 hours: Provide fatality management services, including body recovery and victim identification, working with territorial and federal agencies to provide temporary mortuary solutions, sharing information with mass care services for reunifying family members and caregivers with missing persons/remains, and providing counseling to the bereaved. |
| Hurricane/ Typhoon | Availability of staffing, resources and proper equipment will be impacted due to major damage to roadways infrastructure, transportation, and buildings. Delay in response from emergency personnel due to injury, property damage, loss of life, and debris on roads.24 Hours after the incident to establish mass-fatality operations.134 Square mile impact area.2000 Fatalities to collect. | Within the first 24 hours: Provide fatality management services, including body recovery and victim identification, working with territorial and federal agencies to provide temporary mortuary solutions, sharing information with mass care services for reunifying family members and caregivers with missing persons/remains, and providing counseling to the bereaved. |
| Explosive Devices | Staffing, resources and proper equipment will be impacted due to major damage to roadways infrastructure, transportation, and buildings. Delay in response from emergency personnel due to injury, property damage or loss of life. Estimated 25 fatalities and 150 persons injured.25 Fatalities to collect.1 Square mile impact area. | Within the first 12 hours: Provide fatality management services, including body recovery and victim identification, working with territorial and federal agencies to provide temporary mortuary solutions, sharing information with mass care services for reunifying family members and caregivers with missing persons/remains, and providing counseling to the bereaved. |

| | | |
|---|---|---|
| Cyberattack | N/A | N/A |

## Infrastructure Systems

**Capability Target:** Response Capability Target: Within 24 hours begin the process to decrease and stabilize immediate infrastructure threats to the affected population, to include survivors in the heavily-damaged zone, nearby communities that may be affected by cascading effects, and mass care support facilities and evacuation processing centers with a focus on life-sustainment and congregate care services. Within 24 hours of an incident begin the process to re-establish critical infrastructure within the affected areas to support ongoing emergency response operations, life sustainment, community functionality, and facilitate the integration of recovery activities. Within 12 hours of an incident begin debris clearance, removal, and disposal operations. Recovery Capability Target: Within 2 years develop a plan with a specified timeline for developing, redeveloping, and enhancing community infrastructures to contribute to resilience, accessibility, and sustainability.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Response Impacts:2 Hospitals affected12 Fire stations affected11 Police stations affected2 Electric and Water generation facilities6 Port facilities134 Square mile impact area 2 Airports | Within 24 hours of an incident, begin damage assessment of water and power facilities, roadways, and government facilities. Within 24 hours of an incident begin structural assessments of all damaged infrastructure (roadways, building structures, medical facilities, etc.). |
| Tsunami | Response Impacts:2 Hospitals affected12 Fire stations affected11 Police stations affected2 Electric and Water generation facilities6 Port facilities134 Square mile | Within 24 hours of an incident, begin damage assessment of water and power facilities, roadways, and government facilities. Within 24 hours of an incident begin structural assessments of all damaged |

| | | |
|---|---|---|
| | impact area 2 Airports | infrastructure (roadways, building structures, medical facilities, etc.). |
| Hurricane/ Typhoon | Response Impacts:2 Hospitals affected12 Fire stations affected11 Police stations affected2 Electric and Water generation facilities6 Port facilities134 Square mile impact area 2 Airports | Within 24 hours of an incident, begin damage assessment of water and power facilities, roadways, and government facilities. Within 24 hours of an incident begin structural assessments of all damaged infrastructure (roadways, building structures, medical facilities, etc.). |
| Explosive Devices | 134 Square mile impact area 1 Fire station affected1 Police station affected | Within 12 hours of an incident, begin damage assessment of water and power facilities, roadways, and government facilities within the impacted area. |
| Cyberattack | Information systems and data bases would be closed to prevent unauthorized access. Daily operations for governmental/ non-governmental agencies | Within 24 hours of an incident begin damage assessment of all information collection and storage systems, data bases, and government facilities. |

## Mass Care Services

**Capability Target:** Within 24 hours, move and deliver resources to meet the needs of disaster survivors, including individuals with special needs and others who may be considered “at-risk”. Within 24 hours Department of Human Services and other supporting agencies (ESF6) will establish, staff, and equip emergency shelters and other temporary housing options ensuring that shelters and temporary housing units are physically accessible for individuals with disabilities and others with access and functional needs.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | An estimated 30 percent of the | Within the first 24 hours of an incident, move |

| | | |
|---|---|---|
| | population will be affected by the earthquake event. Houses and apartment building suffer structural damage. Affected population will need sheltering, feeding, and medical care. | and deliver resources and capabilities to meet the needs of disaster survivors, including individuals with special needs individuals and others who may be considered "at-risk". Provide life-sustaining services to the affected population (estimated 106,000 territory wide) with a focus on hydration, feeding, and sheltering to those who have the most need, as well as support for reunifying families. |
| Tsunami | 20,000 displaced survivors. 1,000 displaced survivors with access and functional needs. 1,000 displaced pets. 2,000 tourists in need of evacuation services | Within the first 24 hours of an incident, move and deliver resources and capabilities to meet the needs of disaster survivors, including individuals with special needs individuals and others who may be considered "at-risk". Provide life-sustaining services to the affected population (estimated 106,000 territory wide) with a focus on hydration, feeding, and sheltering to those who have the most need, as well as support for reunifying families. |
| Hurricane/ Typhoon | 134 square miles are across 4 islands10,000 residents in need of food and shelter. Roads blocked by heavy debris and/or damaged by storm surge erosion or flooding. Buildings severely damaged or destroyed by winds and storm surge. | Within the first 24 hours of an incident, move and deliver resources and capabilities to meet the needs of disaster survivors, including individuals with special needs individuals and others who may be considered "at-risk". Provide life-sustaining services to the affected population (estimated 106,000 territory wide) with a focus on hydration, feeding, and sheltering to those who have the most need, as well as support for reunifying families. |
| Explosive Devices | 1 square mile area. Estimated 150 injured people and 25 dead. Major disruptions to the roads in the blast area due to damage and debris. | Within the first 6 hours of an incident, move and deliver resources and capabilities to meet the needs of disaster survivors, including individuals with special needs individuals and others who may be |

| | | |
|---|---|---|
| | | considered “at-risk”. Provide life-sustaining services to the affected population with a focus on hydration, feeding, and sheltering to those who have the most need, as well as support for reunifying families. |
| Cyberattack | N/A | N/A |

## Mass Search and Rescue Operations

**Capability Target:** During the first 12 hours of incident, conduct search and rescue operations to locate and rescue persons in distress, based on the requirements of local authorities. Initiate community based search and rescue support operations across a wide geographically dispersed area. Ensure the synchronized deployment of local, regional, national and international teams to reinforce ongoing search and rescue efforts and transition to recovery.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Low lying tsunami inundation zones on St. Croix, St. John, and St. Thomas. Built up coastal areas on St. Croix, St. John, and St. Thomas.134 Square Mile area across 4 islands | During the first 12 hours of an incident, conduct search and rescue operations to locate and rescue persons in distress. Deploy all search and rescue capabilities, including personnel, services, animals, and assets to survivors in need, with the goal of saving the greatest number of endangered lives in the shortest time possible. |
| Tsunami | Low lying tsunami inundation zones on St. Croix, St. John, and St. Thomas. | During the first 12 hours of an incident, conduct search and rescue operations to locate and rescue persons in distress. Deploy all search and rescue capabilities, including personnel, services, animals, and assets to survivors in need, with the goal of saving the greatest number of endangered lives in the shortest time possible. |

| | | |
|---|---|---|
| Hurricane/ Typhoon | Low lying tsunami inundation zones on St. Croix, St. John, and St. Thomas. Built up coastal areas on St. Croix, St. John, and St. Thomas.134 Square Mile area across 4 islands | During the first 12 hours of an incident, conduct search and rescue operations to locate and rescue persons in distress. Deploy all search and rescue capabilities, including personnel, services, animals, and assets to survivors in need, with the goal of saving the greatest number of endangered lives in the shortest time possible. |
| Explosive Devices | 1 Square mile impact area2 Territorial official buildings | During the first 12 hours of an incident, conduct search and rescue operations to locate and rescue persons in distress. Deploy all search and rescue capabilities, including personnel, services, animals, and assets to survivors in need, with the goal of saving the greatest number of endangered lives in the shortest time possible. |
| Cyberattack | N/A | N/A |

## Operational Communications

**Capability Target:** During the first 12 hours of an incident, complete a damage assessment and begin restoration of 12 communication and deploy 1 mobile tower on each island to cover gaps for towers that cannot be quickly be restored to operation across 3 islands.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 134 Square mile impact area12 Communications towers across 3 islands Ability to begin damage assessments and repairs of communications systems within 12 hours of the incident | Assess damage and begin to restore communication service within 12 hours of an incident |

| | | |
|---|---|---|
| Tsunami | 134 Square mile impact area12 Communications towers across 3 islands Ability to begin damage assessments and repairs of communications systems within 12 hours of the incident | Assess damage and begin to restore communication service within 12 hours of an incident |
| Hurricane/ Typhoon | 134 Square mile impact area12 Communications towers across 3 islands. Ability to begin damage assessments and repairs of communications systems within 12 hours of the incident | Assess damage and begin to restore communication service within 12 hours of an incident |
| Cyberattack | N/A | N/A |
| Explosive Devices | Cell phone services may be affected because of overloaded calls through severs. 911 Emergency Call Center systems overloaded due to high frequency of calls requesting assistance.1 Square mile impact area | Establish and maintain interoperable voice and data communications between emergency responders. |

## Situational Assessment

**Capability Target:** Within 2 hours of the incident, gather and compile situation reports from 18 territorial agencies to develop and maintain a common operating picture. On a 12 hour, operational period (or as the situation dictates), provide initial and continuous notification of 8 response and recovery partners on the current and probable future situation, verify facts (e.g. incident-related deaths, impassable nodes, shelter counts), and obtain manifests and information on foreseeable and actual adverse cascading events.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 2 hours within an incident occurring to gather and compile situation reports<br><br>18 Territorial agencies to gather information from<br><br>12 Hour of operational period (cycle)<br><br>8 Response and recovery partners to notify of SA status (VI FS, VI PD, EMS, Rescue, ARC, DHS, DOH, DPW) | Provide all decision makers with decision-relevant information regarding the nature and extent of the hazard, any cascading effects, and the status of the response. |
| Tsunami | 2 hours within an incident occurring to gather and compile situation reports<br><br>18 Territorial agencies to gather information from<br><br>12 Hour of operational period (cycle)<br><br>8 Response and recovery partners to notify of SA status (VI FS, VI PD, EMS, Rescue, ARC, DHS, DOH, DPW) | Provide all decision makers with decision-relevant information regarding the nature and extent of the hazard, any cascading effects, and the status of the response. |
| Hurricane/ Typhoon | 2 hours within an incident occurring to gather and compile situation reports<br><br>18 Territorial agencies to gather information from | Provide all decision makers with decision-relevant information regarding the nature and extent of the hazard, any cascading effects, and the status of the response. |

| | | |
|---|---|---|
| | 12 Hour of operational period (cycle)<br><br>8 Response and recovery partners to notify of SA status (VI FS, VI PD, EMS, Rescue, ARC, DHS, DOH, DPW) | |
| Explosive Devices | 2 hours within an incident occurring to gather and compile situation reports<br><br>18 Territorial agencies to gather information from<br><br>12 Hour of operational period (cycle)<br><br>8 Response and recovery partners to notify of SA status (VI FS, VI PD, EMS, Rescue, ARC, DHS, DOH, DPW) | Provide all decision makers with decision-relevant information regarding the nature and extent of the hazard, any cascading effects, and the status of the response. |
| Cyberattack | 2 hours within an incident occurring to gather and compile situation reports<br><br>18 Territorial agencies to gather information from<br><br>12 Hour of operational period (cycle)<br><br>8 Response and recovery partners to notify of SA status (VI FS, VI PD, EMS, Rescue, ARC, DHS, DOH, DPW) | Provide all decision makers with decision-relevant information regarding the nature and extent of the hazard, any cascading effects, and the status of the response. |

## Economic Recovery

**Capability Target:** Within 7 days of an incident, assign economic development assessment teams to conduct a preliminary damage assessment to determine impacts to economic and business recovery, and identify requirements for enhanced territorial or Federal support. Within 8 weeks, develop a plan in concert with economic development team and whole community partners to restore infrastructure sites (grocery stores, banks, tourism) to contribute to resiliency, accessibility, and sustainability of the economy. Within 12 months, develop a plan that identifies pre-disaster mitigation and post-disaster actions that build economic resiliency and reduce recovery delays.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 7 Days within incident to conduct economic impacts assessments8 Weeks to develop plan with whole community partners12 Months to develop economic resiliency plans | Return economic and business activities (including food and agriculture) to a healthy state and develop new business and employment opportunities that result in a sustainable and economically viable territory within 3 years of an incident. |
| Tsunami | 7 Days within incident to conduct economic impacts assessments8 Weeks to develop plan with whole community partners12 Months to develop economic resiliency plans | Return economic and business activities (including food and agriculture) to a healthy state and develop new business and employment opportunities that result in a sustainable and economically viable territory within 3 years of an incident. |
| Hurricane/ Typhoon | 7 Days within incident to conduct economic impacts assessments8 Weeks to develop plan with whole community partners12 Months to develop economic resiliency plans | Return economic and business activities (including food and agriculture) to a healthy state and develop new business and employment opportunities that result in a sustainable and economically viable territory within 3 years of an incident. |

| | | |
|---|---|---|
| Explosive Devices | 7 Days within incident to conduct economic impacts assessments8 Weeks to develop plan with whole community partners12 Months to develop economic resiliency plans | Return economic and business activities (including food and agriculture) to a healthy state and develop new business and employment opportunities that result in a sustainable and economically viable territory within 3 years of an incident. |
| Cyberattack | 7 Days within incident to conduct economic impacts assessments8 Weeks to develop plan with whole community partners12 Months to develop economic resiliency plans | Return economic and business activities (including food and agriculture) to a healthy state and develop new business and employment opportunities that result in a sustainable and economically viable territory within 3 years of an incident. |

## Health and Social Services

**Capability Target:** Within 3 days of an incident, conduct an assessment of the community health and social service needs for 106,000 residents, including at-risk individuals, including children, populations with limited English proficiency, and those with access/functional needs, in the affected area.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 106,000 residents that identifies at-risk individuals, including children, populations with limited English proficiency, and those with disabilities and access/functional needs. | Conduct an assessment of the community health and social service needs of residents in the affected area within 3 days of an incident. |
| Tsunami | 106,000 residents that identifies at-risk individuals, including children, populations with limited English proficiency, and those with disabilities and access/functional | Conduct an assessment of the community health and social service needs of residents in the affected area within 3 days of an incident. |

| | | |
|---|---|---|
| | needs. | |
| Hurricane/ Typhoon | 106,000 residents that identifies at-risk individuals, including children, populations with limited English proficiency, and those with disabilities and access/functional needs. | Conduct an assessment of the community health and social service needs of residents in the affected area within 3 days of an incident. |
| Explosive Devices | 106,000 residents that identifies at-risk individuals, including children, populations with limited English proficiency, and those with disabilities and access/functional needs | Conduct an assessment of the community health and social service needs of residents in the affected area within 3 days of an incident. |
| Cyberattack | N/A | N/A |

## Housing

**Capability Target:** Within 24 hours of an incident begin preliminary assessment of housing impacts and needs, identify available options for temporary housing of 1500 displaced households, and implement sheltering options. Within 48 hours of an incident begin implementation of housing solutions that effectively support the needs of the whole community and contribute to its sustainability and resilience. Identify housing requirements and available housing, including accessible options for; all families and individuals needed to be sheltered, animals (pets) needing shelter and residences with homes destroyed along with accessibility for people with special needs.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Identify housing requirements and | Within 24 hours of an incident begin |

| | | |
|---|---|---|
| | available housing, including accessible options for:<br><br>Approximately 20,000 people sheltered.<br><br>Over 1,500 residences destroyed.<br><br>Government offices and Private sector buildings destroyed. | preliminary assessment of housing impacts and needs, identify available options for temporary housing, and implement sheltering options. Implement housing solutions that effectively support the needs of the whole community and contribute to its sustainability and resilience. |
| Tsunami | Identify housing requirements and available housing, including accessible options for:<br><br>Approximately 20,000 people sheltered.<br><br>Over 1,500 residences destroyed.<br><br>Government offices and Private sector buildings destroyed. | Within 24 hours of an incident begin preliminary assessment of housing impacts and needs, identify available options for temporary housing, and implement sheltering options. Implement housing solutions that effectively support the needs of the whole community and contribute to its sustainability and resilience. |
| Hurricane/ Typhoon | Identify housing requirements and available housing, including accessible options for: Approximately 20,000 people sheltered. Over 1,500 residences destroyed. Government offices and Private sector buildings destroyed. | Within 24 hours of an incident begin preliminary assessment of housing impacts and needs, identify available options for temporary housing, and implement sheltering options. Implement housing solutions that effectively support the needs of the whole community and contribute to its sustainability and resilience. |
| Explosive Devices | Identify housing requirements and available housing, including accessible options for: Approximately 2,000 people to be temporarily sheltered. Residences and businesses destroyed as result of incident. | Within 24 hours of an incident begin preliminary assessment of housing impacts and needs, identify available options for temporary housing, and implement sheltering options. Implement housing solutions that effectively support the needs of the whole community and contribute to its sustainability and resilience. |

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| Cyberattack | N/A | N/A |

## Natural and Cultural Resources

**Capability Target:** Within 5 days of an incident, commence 100 cultural, and historic property resource damage assessments, using volunteer organizations and territorial/federal agencies involved in natural and cultural resource recovery. Within 6 months of an incident, restore/reopen/remediate multiple museums/libraries and historic properties. Returning them to pre-disaster conditions and/or implementing protective actions will involve another 18 months. Within 12 months of an incident, develop a plan to mitigate future impacts and stabilize multiple cultural resources.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 213 historic structures | Initial damage assessments should occur within 1 week of an incident. Mitigation operations should begin within 1 month of an incident and continue for another 5 years. |
| Tsunami | 153 prehistoric sites400 historic structures | Initial damage assessments should occur within 1 week of an incident. Mitigation operations should begin within 1 month of an incident and continue for another 5 years. |
| Hurricane/ Typhoon | 153 prehistoric sites213 historic structures | Initial damage assessments should occur within 2 weeks of an incident. Mitigation operations should begin within 3 months of an incident and continue for another 9 months. |
| Explosive Devices | 1 Historical structure | Initial damage assessments should occur within 1 week of an incident. Mitigation operations should begin within 1 month of an incident and continue for another 5 years. |

| | | |
|---|---|---|
| Cyberattack | N/A | N/A |

## On-scene Security, Protection, and Law Enforcement

**Capability Target:** During the first 72 hours, Establish a safe and secure environment in an affected area. Provide and maintain on-scene security and meet the protection needs of the affected population over a 134-square mile area on three islands while eliminating or mitigating the risk of further damage to persons, property, and the environment.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 134 Square mile impact area across 4 islands20,000 People affected 2 Hospitals32 Shelters | Ensure a safe and secure environment through law enforcement and related security and protection operations for people and communities located within affected areas and for response personnel engaged in lifesaving and life-sustaining operations. |
| Tsunami | 134 Square mile impact area across 4 islands20,000 People affected 2 Hospitals32 Shelters | Ensure a safe and secure environment through law enforcement and related security and protection operations for people and communities located within affected areas and for response personnel engaged in lifesaving and life-sustaining operations. |
| Hurricane/ Typhoon | 134 Square mile impact area across 4 islands20,000 People affected 2 Hospitals32 Shelters | Ensure a safe and secure environment through law enforcement and related security and protection operations for people and communities located within affected areas and for response personnel engaged in lifesaving and life-sustaining operations. |
| Explosive Devices | 1 Square mile1 hospital | Ensure a safe and secure environment through law enforcement and related security |

| | | |
|---|---|---|
| | | and protection operations for people and communities located within affected areas and for response personnel engaged in lifesaving and life-sustaining operations. |
| Cyberattack | N/A | N/A |

## Threats and Hazards Identification

**Capability Target:** Identify and provide context for 5 of the worst-case, plausible threats and hazards to the region every 2 years in collaboration with whole community partners and incorporate it into the analysis and planning processes. Every 2 years, update the threats and hazards list with known and emerging threats and hazards and use pertinent models to estimate potential consequences in collaboration with all partners.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 5 Worst-case, plausible threats and hazards to assess5 Year-cycle to update threats and hazards analysis134 square miles with 106,000 residents | Identify the threats and hazards that occur in the territory; determine the frequency and magnitude; and incorporate all data into analysis and planning processes. |
| Tsunami | 5 Worst-case, plausible threats and hazards to assess5 Year-cycle to update threats and hazards analysis134 square miles with 106,000 residents | Identify the threats and hazards that occur in the territory; determine the frequency and magnitude; and incorporate all data into analysis and planning processes. |
| Hurricane/ Typhoon | 5 Worst-case, plausible threats and hazards to assess5 Year-cycle to update threats and hazards analysis134 square miles with 106,000 residents | Identify the threats and hazards that occur in the territory; determine the frequency and magnitude; and incorporate all data into analysis and planning processes. |

| | | |
|---|---|---|
| Explosive Devices | 5 Worst-case, plausible threats and hazards to assess5 Year-cycle to update threats and hazards analysis134 square miles with 106,000 residents | Identify the threats and hazards that occur in the territory; determine the frequency and magnitude; and incorporate all data into analysis and planning processes. |
| Cyberattack | 5 Worst-case, plausible threats and hazards to assess5 Year-cycle to update threats and hazards analysis134 square miles with 106,000 residents | Identify the threats and hazards that occur in the territory; determine the frequency and magnitude; and incorporate all data into analysis and planning processes. |

## Fire Management and Suppression

**Capability Target:** STT - Conduct life-saving and firefighting operations in response to a structural fire within 5 minutes of notification and maintain operations for 2 hours. STJ - Conduct life-saving and firefighting operations in response to a structural fire within 5 minutes of notification and maintain operations for 1 hours. STX - Conduct life-saving and firefighting operations in response to a wildland fire within 5 minutes of notification and maintain operations for 2 hours. Within the next two years increase water sourcing capabilities thru MOUs with private Water Haulers and water storage bladders

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 11 Fire stations affected (STT - 4, STJ - 2, Water island - 1, STX - 4), and 134 Square mile impact area. Response times delayed due to debris on roadways. Fire station crews working double shifts due to manpower shortages | STT - Conduct life-saving and firefighting operations in response to a structural fire within 7 minutes of notification and maintain operations for 2 hours. STJ - Conduct life-saving and firefighting operations in response to a structural fire within 12 minutes of notification and maintain operations for 1 hours. STX - Conduct life- |

| | | |
|---|---|---|
| | | saving and firefighting operations in response to a wildland fire within 7 minutes of notification and maintain operations for 2 hours. |
| Tsunami | 11 Fire stations affected (STT - 4, STJ - 2, Water island - 1, STX - 4), 134 Square mile impact area. Response times delayed due to debris on roadways. Fire station crews working double shifts due to manpower shortages | STT - Conduct life-saving and firefighting operations in response to a structural fire within 7 minutes of notification and maintain operations for 2 hours. STJ - Conduct life-saving and firefighting operations in response to a structural fire within 12 minutes of notification and maintain operations for 1 hours. STX - Conduct life-saving and firefighting operations in response to a wildland fire within 7 minutes of notification and maintain operations for 2 hours. |
| Hurricane/ Typhoon | 11 Fire stations affected (STT - 4, STJ - 2, Water island - 1, STX - 4), 134 Square mile impact area. Response times delayed due to debris on roadways. Fire station crews working double shifts due to manpower shortages | STT - Conduct life-saving and firefighting operations in response to a structural fire within 7 minutes of notification and maintain operations for 2 hours. STJ - Conduct life-saving and firefighting operations in response to a structural fire within 12 minutes of notification and maintain operations for 1 hours. STX - Conduct life-saving and firefighting operations in response to a wildland fire within 7 minutes of notification and maintain operations for 2 hours. |
| Explosive Devices | 1 Fire stations affected1 Square mile impact area Response times delayed due to debris on roadways | STT - Conduct life-saving and firefighting operations in response to a structural fire within 5 minutes of notification and maintain operations for 2 hours. STJ - Conduct life-saving and firefighting operations in response to a structural fire within 5 minutes of notification and maintain operations for 1 hours. STX - Conduct life-saving and firefighting operations in response to a |

| | | |
|---|---|---|
| | | wildland fire within 5 minutes of notification and maintain operations for 2 hours. |
| Cyberattack | N/A | N/A |

## Logistics and Supply Chain Management

**Capability Target:** Establish, staff, and supply up to 21 points of distribution to deliver life-sustaining resources to 106,000 residents across 4 islands within 24 hours of an incident.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | 134 Square mile impact area106,000 residents across 4 islands21 Point of Distribution sites located in the disaster area | Establish, staff, and supply PODs within 24 hours of an incident |
| Tsunami | 134 Square mile impact area106,000 residents across 4 islands21 Point of Distribution sites located in the disaster area | Establish, staff, and supply PODs within 24 hours of an incident |
| Hurricane/ Typhoon | 134 Square mile impact area106,000 residents across 4 islands21 Point of Distribution sites located in the disaster area | Establish, staff, and supply PODs within 24 hours of an incident |
| Explosive Devices | N/A | N/A |
| Cyberattack | Resources and services will be delayed due to cyberattacks on information, financial systems, and databases throughout the population (to include tourist and visitors). Emergency staff will be | Deliver essential commodities, equipment, and services in support of impacted communities and survivors, to include emergency power and fuel support, as well as the coordination of access to community staples. Synchronize logistics capabilities |

| | | |
|---|---|---|
| | directly affected by this cyberattacks event. | and enable the restoration of impacted supply chains. |

## Public Health, Healthcare, and Emergency Medical Services

**Capability Target:** Within 12 hours of an incident, deliver countermeasures to exposed populations, complete triage and initial stabilization of 3000 casualties, and provide definitive medical care for people likely to survive their injuries or illnesses.

| Threat or Hazard | Impact Statement(s): | Outcome Statement(s): |
|---|---|---|
| Earthquake | Estimated 200 fatalities and 3,000 injuries. Ability to begin delivering countermeasures and medical care within 3 hours of an incident. | Provide lifesaving medical treatment via Emergency Medical Services and related operations and avoid additional disease and injury by providing targeted public health, medical, behavioral health support, and products to all affected populations. |
| Tsunami | Estimated 200 fatalities and 3,000 injuries. Ability to begin delivering countermeasures and medical care within 3 hours of an incident. | Provide lifesaving medical treatment via Emergency Medical Services and related operations and avoid additional disease and injury by providing targeted public health, medical, behavioral health support, and products to all affected populations. |
| Hurricane/ Typhoon | Estimated 200 fatalities and 3,000 injuries Ability to begin delivering countermeasures and medical care within 3 hours of an incident. | Provide lifesaving medical treatment via Emergency Medical Services and related operations and avoid additional disease and injury by providing targeted public health, medical, behavioral health support, and products to all affected populations. |
| Explosive Devices | Estimated 500 fatalities and 2,500 injuries | Provide lifesaving medical treatment via Emergency Medical Services and related operations and avoid additional disease and injury by providing targeted public health, |

| | | |
|---|---|---|
| | | medical, behavioral health support, and products to all affected populations. |
| Cyberattack | N/A | N/A |

## THIRA Journal Notes

### Planning

Revise impacts block:

Revise desired outcomes block:

- Mitigation: discuss training and plans

### Operational Communications

Revise Impacts block

Revise Desired Outcome block

### Public Health and Medical Services

Revise both blocks

### Fire Management and Suppression

Discuss recommend comments with VI FS in both districts

# THIRA Step 4: Apply the Results

## Planning

**Capability Target:**

PREVENTION: Implement operational prevention plans that dictate the roles and responsibilities and the sequence and scope of tasks needed to prevent an incident across a 134-square mile area with 106,000 residents within 30 minutes of notification of an imminent, credible terrorist threat.

PROTECTION: Review and update protection plans with at least 4 whole community partners, including representatives of individuals with disabilities and those with access and functional needs, every year.

MITIGATION: Every 5 years, update the hazard mitigation plan addressing all the mission areas, with specific annexes as required. Engage whole community partners as appropriate in mitigation planning to meet defined objectives.

RESPONSE: Coordinate with at least 4 territorial agencies year to insure they have current EOPs and COOP plans in place. Support at least 4 territorial agencies and NGOs in reviewing and updating their respective EOP each year. Engage at least 4 whole community partners each year on response planning I support of Territorial objectives. Revise and update the USVI Territorial Emergency Operations Plan by the 11/30/16.RECOVERY: Evaluate, update, and maintain a COOP plan every 5 years for all territorial agencies. Engage whole community partners as appropriate in recovery planning to meet defined objectives.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Planning Section Chief (Type 3) | III | 3 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Mitigation | Type I Hazard Mitigation Planning Team | 1 |
| Other | Economic Recovery Planner | 2 |
| Other | COOP Planner | 1 |
| Other | Emergency Planning Coordinator | 1 |

## Public Information and Warning

**Capability Target:**

Prevention Capability Target: Within 10 (ten) minutes, and using a variety of delivery systems, share all actionable messages, to include NTAS alerts, with 100 percent of the public and other stakeholders, as appropriate, to aid in the prevention of imminent or follow-on terrorist attacks, consistent with the timeline specified by existing processes and protocols. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring warnings and information reach individuals with access and functional needs or limited English proficiency.

Protection Capability Target: Operate effective and accessible indication and warning systems to communicate significant threats and hazards to all 106,000 residents, including involved operators, security officials, and the public (including alerts, detection capabilities, and other necessary and appropriate assets), within one hour of a potential or actual threat/hazard. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating

messaging with all stakeholders to be sure consistency and clarity, and ensuring warnings and information reach individuals with access and functional needs or limited English proficiency.

Mitigation Capability Target: Provide 106,000 residents with useful and relevant information on the threats and hazards faced by the community and how to prepare for them. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring warnings and information reach individuals with access and functional needs or limited English proficiency.

Response Capability Target: Within one (1) hour of a declared emergency or disaster, inform 106,000 people within the affected area by all means necessary, including accessible tools, of critical lifesaving, life-sustaining, and actionable information to expedite the delivery of emergency services and aid the public in taking protective actions. Deliver public information and warnings in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring information reaches individuals with access and functional needs or limited English proficiency.

Recovery Capability Target: Within six (6) hour after the threat of an emergency or disaster event has passed, the Joint Information Center reaches 106,000 people within the affected area with actionable, recovery-related public information. Deliver public information in culturally and linguistically appropriate ways through multiple channels, to include using social media, coordinating messaging with all stakeholders to be sure consistency and clarity, and ensuring information reaches individuals with access and functional needs or limited English proficiency.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Incident Management | Public Information Officer (Type 3) | III | 2 |

**Other Resources**

| Category: | Resource: | Number Required: |
|---|---|---|
| Other | Public Information Officer with Spanish bilingual skills | 2 |

## Operational Coordination

**Capability Target:**

PREVENTION: Establish unified command structures to coordinate prevention activities with law enforcement/responders within 30 minutes of notification of a credible threat.

PROTECTION: Conduct an audit every 6 months to ensure all Emergency Operation Center personnel have completed Incident Command Systems training (or equivalent training) and all Emergency Operation Center supervisory personnel have completed Multiagency Coordination Systems training (or equivalent training).

MITIGATION: Collaborate with whole community partners on mitigations projects every 3 years. RESPONSE: Coordinate with territorial agencies, federal partners, non-governmental and private sector partners to provide emergency support services to 106,000 residents across 4 islands within 3 days of an incident.

RECOVERY: Establish a process for acquiring funding and assistance from Federal and Territorial entities, as well as non-governmental and private sector partners to support the recovery of 106,000 residents across 4 islands within 3 days of an incident.

**NIMS-typed Resources**

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Animal Emergency Response | Incident Management Team Animal Protection | III | 2 |
| Fire/Hazardous Materials | Area Command Team, Firefighting | I | 2 |
| Incident Management | EOC Management Support Team | I | 2 |
| Incident Management | Incident Management Team | I | 2 |
| Incident Management | EOC Operations Section Chief | I | 2 |
| Incident Management | Logistics Section Chief (Type 3) | III | 2 |
| Incident Management | Finance/Administration Section Chief (Type 3) | III | 2 |
| Incident Management | Liaison Officer (Type 3) | III | 2 |
| Incident Management | Incident Management Team | III | 2 |
| Incident Management | Incident Commander (IC) (Type 3) | III | 2 |
| Incident Management | | | 0 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Incident Management | Press/News Media | 1 |
| Incident Management | Safety Officer | 2 |

## Forensics and Attribution

**Capability Target:** Conduct site exploitation for evidence, physical evidence analysis, biometric and DNA analysis, and digital media and network exploitation in the first 48 hours of a complex event, with the goal of preventing a follow-on attack. Prioritize,

collect, and examine 85 percent of evidence associated with an act of terrorism or an imminent terrorist attack and all critical infrastructure sectors. Identify 100 percent of the terrorist actors, co-conspirators, and their sponsors by fusing all science-based forensic results and all source intelligence information and products across all critical infrastructure sectors. In coordination with Federal partners, prioritize the collection and processing of debris, plus 75 percent of all trace, digital, and/or biometric evidence, within 72 hours of an attack to identify the perpetrator(s) and prevent future attacks.

**NIMS-typed Resources**

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Fire/Hazardous Materials | HazMat Entry Team | I | 1 |
| Law Enforcement Operations | SWAT/Tactical Teams | I | 1 |
| Law Enforcement Operations | Bomb Squad/Explosives Team | I | 1 |
| Medical and Public Health | Epidemiology (Surveillance and Investigation) | I | 1 |

**Other Resources**

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Intelligence and Information Sharing

**Capability Target:** PREVENTION Capability Target: Within 24 hours of receiving actionable intelligence, develop actionable products and disseminate the information to all federal, state, local,

territorial, private sector, and international partners. In the immediate aftermath of an incident, develop real time analysis products every 3 hours. Within 24 hours of an incident, answer requests for information (RFI's) and analyze all suspicious activity reports and other intelligence information to provide intelligence products to all first responder communities and decision makers to assist in operational requirements. PROTECTION Capability Target: Within 24 hours of receiving intelligence from law enforcement, first responders, and emergency call centers, disseminate actionable intelligence and information to key stakeholders from all government agencies and/or private sector organizations. Within 72, develop information and intelligence gathering priorities in response to a dynamic threat scenario with a potential for follow-on attacks and ensure identification and tasking of all available intelligence assets to support these priorities.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | EOC Management Support Team | I | 2 |
| Incident Management | Public Information Officer (Type 3) | III | 1 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Other | Virgin Islands Fusion Center- All Hazards | 1 |

## Interdiction and Disruption

**Capability Target:** PREVENTION: Support tactical counterterrorism operations across a 134-square mile area within 12 hours of notification of a credible threat. Within 72 hours of their discovery, conduct operations to render safe and dispose of CBRNE hazards in all affected locations simultaneously over a 32-

square mile area. Within 2 hours of their detection, interdict conveyances, cargo, or persons associated with an imminent threat to all airports and seaport facilities. Conduct multiple simultaneous tactical counterterrorism operations in up to two separate locations on consecutive days and in all environments. Locate, apprehend, transport, and hold 100 percent of the migrant border crossers per day moving throughout the international border area. Deploy specialized tactical alert teams, bomb squads, or EOD units within 24 hours to prevent initial or follow-on terrorist attacks.

PROTECTION: Establish and continually update procedures and protocols for securing Carnival village within 30 minutes of identifying a threat or hazard. Increase the visible presence of law enforcement by 50 percent to deter or disrupt threats from reaching potential targets such as major public gatherings, and transportation hubs. Ensure the interdiction of 100 percent of all conveyances, cargo, and persons associated with any human-caused threat or act to prevent an incident from occurring or eliminate the risk of future acts to an area covering the Virgin Islands territories.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Law Enforcement Operations | Law Enforcement Aviation - Helicopters - Patrol and Surveillance | II | 2 |
| Law Enforcement Operations | SWAT/Tactical Teams | II | 2 |
| Law Enforcement Operations | Law Enforcement Observation Aircraft (Fixed-Wing) | II | 2 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Law Enforcement | Marine Interdiction Team | 2 |

Operations

## Screening, Search, and Detection

**Capability Target:** PROTECTION: Work with federal agencies to screen 100 percent of areas used by employees, travelers, mail, cargo and conveyances using technical, non-technical, intrusive and non-intrusive means without hampering the flow of legitimate commerce. Work with federal agencies to screen 100 percent of targeted conveyances, cargo, and persons associated with illegal activities and criminal intent, whose actions may pose as an imminent terrorist threat using all means possible. Implement the “See something Say Something” campaign to reach 106,000 residents across 4 islands and 134 Square miles. Work with federal agencies to locate persons and criminal/terrorist networks associated with a potential threat.

PREVENTION Capability Target: Work with federal agencies to conduct 100 percent of CBRNE search/detection operations in all locations and in all environments, consistent with established protocols. Work with federal agencies to screen all people and shipping vessels to identify 100 percent of imminent terrorist threats using technical, non-technical, intrusive, or non-intrusive means, consistent with established protocols. Work with federal agencies to screen 100 percent of patrons, vendors, and employees associated with a mass gathering or special event when there is intelligence or information to indicate the event may be the target of a terrorist attack. Support federal agencies in screening and detecting 100 percent of foodborne, agricultural, and biological threats.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Law Enforcement Operations | Bomb Squad/Explosives Team | I | 2 |
| Law Enforcement | Law Enforcement Aviation - | II | 2 |

| | | | |
|---|---|---|---|
| Operations | Helicopters - Patrol and Surveillance | | |
| Medical and Public Health | Epidemiology (Surveillance and Investigation) | II | 2 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| | No Response | |

# Access Control and Identity Verification

**Capability Target:** Verify access rights to 100 percent of vendors and staff of all priority critical infrastructure and key resources locations and key government facilities to grant or deny access to specific locations or information. Using physical and technological means, establish access control and identity verification for 100 percent of all law enforcement, response, and emergency management personnel at multiple sites and EOCs and ensure rapid and effective credentialing before, during, or after an incident. Verify and control access through physical, technological, and cyber measures for 100 percent of all personnel to critical locations and systems, limiting access to individuals authorized to carry out legitimate activities in the affected areas. Ensure that 100 percent of all vendors, employees, and drivers display valid credentials authorizing them access to critical locations.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Law Enforcement Operations | Law Enforcement Patrol Team (Strike Team) | I | 1 |
| Law Enforcement Operations | SWAT/Tactical Teams | II | 1 |
| Law Enforcement | Mobile Field Force Law | II | 1 |

| | | |
|---|---|---|
| Operations | Enforcement (Crowd Control Teams) | |

**Other Resources**

| Category: | Resource: | Number Required: |
|---|---|---|
| | No Response | |

## Cybersecurity

**Capability Target:** Within two years formalize partnerships with governmental and private sector cyber incident or emergency response teams to accept, triage, and collaboratively respond to incidents in an efficient manner. Within two years formalize partnerships between communities and disciplines responsible for cyber security and physical systems dependent on cyber security. Within two years formalize relationships between information communications technology and information system vendors and their customers for ongoing product cyber security, business planning, and transition to response and recovery when necessary.

**NIMS-typed Resources**

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| | No Response | | |

**Other Resources**

| Category: | Resource: | Number Required: |
|---|---|---|
| | No Response | |

## Physical Protective Measures

**Capability Target:** Implement and maintain risk informed physical protection, countermeasures, and policies protecting 100 percent people, critical infrastructure and key resources, borders, and systems associated with key operational activities and critical infrastructure sectors. Implement and maintain risk-informed physical protections, countermeasures, and policies, protecting all public sector critical infrastructure and key resources facilities, 100 percent jurisdiction-operated internet systems, and those materials, products, and systems associated with critical infrastructure sectors and other key operational activities. Encourage 100 percent private sector critical infrastructure and key resources owners and operators to do likewise. Harden physical protective measures for 100 percent high priority critical infrastructure and key resources assets with moderate to very high vulnerability to natural and technological hazards and manmade intentional threats.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Fire/Hazardous Materials | Plans Examiner I/II | I | 2 |
| Law Enforcement Operations | Law Enforcement Patrol Team (Strike Team) | II | 2 |
| Law Enforcement Operations | Law Enforcement Observation Aircraft (Fixed-Wing) | II | 1 |
| Law Enforcement Operations | Law Enforcement Aviation - Helicopters - Patrol and Surveillance | II | 1 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Risk Management for Protection Programs and Activities

**Capability Target:** Every 5 years, complete and maintain updated risk assessments for all recognized high-priority critical infrastructure and key resources (such as Water and Power Authority, all enter and exit Cargo and Commercial ports, Hospital, etc.) and communicate using outreach to potential target assets (Private owned companies and businesses) in the territory. Assemble risk assessments to recognize and prioritize protection actions that can be implemented for 2 hospitals that require protective measures. Every 3 years, update risk assessments for government facilities, critical infrastructure and key resources, and whole community assets (e.g., residential, neighborhoods, community facilities). Build the capability within communities to analyze and assess risk and resilience for 106,000 residents on four islands.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Rapid Needs Assessment Team | I | 2 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Supply Chain Integrity and Security

**Capability Target:** Ensure protocols are in place to increase security and law enforcement support at major supply chain nodes, Logistics Staging Areas (LSAs), and/or Points of Distribution (PODs) across 4 islands within 12 hours of notification of a credible threat or hazard.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| | No Response | | |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Other | Critical infrastructure Specialist | 1 |
| Other | Hazard Mitigation Officer | 1 |

# Community Resilience

**Capability Target:** Ensure that 106,000 people in the impacted area are supported by a risk-informed, risk-conscious, mitigation process designed to improve resilience at every level through community leadership, collaboration, partnership building, education, and skill building. Using various communication means, incorporate the message that “physical/virtual security is a shared responsibility" between sectors and between governments and citizens that results in preparing 106,000 people for self-reliance during events using instruction on sustainable protective measures that could be implemented. Ensure 106,000 individuals in the affected area are educated regarding measures to be taken to safeguard their homes and businesses. Conduct at least 12 outreach events each year to business and community groups, and during community events to enable the recognition, understanding, communication of, and planning for risk and empower individuals and communities to make informed risk management decisions necessary to adapt to, withstand, and quickly recover from future incidents.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Public Information Officer (Type 3) | III | 1 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Incident Management | Tsunami Siren System | 2 |

# Long-term Vulnerability Reduction

**Capability Target:** Complete approved and funded vulnerability reduction projects listed in the 2014 Hazard Mitigation Plan within the grant period of performance. Complete at least 2 mitigation training courses for territorial agencies, businesses, and the public to improve mitigation awareness

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Individual Assistance Disaster Assessment Team | I | 1 |
| Incident Management | Incident Management Team | I | 1 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Incident Management | Virgin Islands Fusion Center/Critical Infrastructure Specialist | 1 |
| Other | Outreach and Training/Emergency Management A | 1 |

gency

## Risk and Disaster Resilience Assessment

**Capability Target:** Complete a risk and disaster resilience assessment to analyze vulnerabilities, resilience capabilities, and estimate impacts of threats and hazards across 4 islands with 106,000 residents every 3 years in accordance with federal and territorial requirements.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Critical Transportation

**Capability Target:** Clear 150 tons of debris on roadways in a 20-square mile area within 7 days of an incident. Open key ports on St. Thomas, St. John, and St. Croix limited operations within 3 days of an incident while recovery operations continue to bring the facilities back to a fully operational status. Airports on St. Thomas and St. Croix are reopened for limited operations within 3 days while recovery operations continue to bring the facilities back to a fully operational status.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Other | Side Scan Sonar | 2 |
| Other | Harbor Assessment Team | 2 |
| Public Works | Airfield assessment Team | 2 |

## Environmental Response/Health and Safety

**Capability Target:** Within 24 hours, conduct health and safety hazard assessments and disseminate guidance and resources, to include deploying hazardous materials teams to support environmental health and safety action for response personnel and the affected population. Minimize public exposure to environmental hazards for 106,000 people within the 134-square mile affected area.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Fire/Hazardous Materials | HazMat Technician | I | 2 |
| Fire/Hazardous Materials | HazMat Safety Officer | I | 2 |
| Fire/Hazardous Materials | HazMat Entry Team | II | 2 |
| Fire/Hazardous Materials | Incident Management Team, Firefighting | III | 2 |
| Medical and Public Health | Environmental Health | I | 2 |
| | U.S. Coast Guard National Strike Force | n/a | 2 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

# Fatality Management Services

**Capability Target:** Within 24 hours of a mass-fatality incident, work with appropriate authorities to establish and maintain operations to recover, identify, document, and establish temporary storage or permanent internment solutions the remains of 2000 fatalities over a 134-square mile area.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Mass Care Services | Fatality Identification/Reunification Team | 2 |
| Other | Victim Information Center (VIC) team | 2 |
| Other | Disaster Mortuary Operational Response Team (DMORT) | 1 |
| Other | Disaster Portable Morgue Unit (DPMU) | 2 |

# Infrastructure Systems

**Capability Target:** Response Capability Target: Within 24 hours begin the process to decrease and stabilize immediate infrastructure

threats to the affected population, to include survivors in the heavily-damaged zone, nearby communities that may be affected by cascading effects, and mass care support facilities and evacuation processing centers with a focus on life-sustainment and congregate care services. Within 24 hours of an incident begin the process to re-establish critical infrastructure within the affected areas to support ongoing emergency response operations, life sustainment, community functionality, and facilitate the integration of recovery activities. Within 12 hours of an incident begin debris clearance, removal, and disposal operations. Recovery Capability Target: Within 2 years develop a plan with a specified timeline for developing, redeveloping, and enhancing community infrastructures to contribute to resilience, accessibility, and sustainability.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Public Works | Concrete Cutter/Multi-Processor for Hydraulic Excavator | I | 2 |
| Public Works | Debris Removal Manager | I | 2 |
| Public Works | Water System Manager | I | 2 |
| Public Works | Emergency Management Support Team - Water/Wastewater | I | 2 |
| Public Works | Damage Assessment and Repair Team - Sewer Mains | I | 2 |
| Public Works | Generators | I | 0 |
| Public Works | Debris Collection Supervisor | I | 2 |
| Public Works | Structural Engineer | I | 2 |
| Public Works | Water Pumps, Water Distribution | I | 2 |
| Public Works | Damage Assessment and Repair | I | 2 |

| | | | |
|---|---|---|---|
| | Team - Water Pump Facilities | | |
| Public Works | Grader | II | 2 |
| Public Works | Grader | III | 1 |
| Public Works | Hydraulic Excavator (Medium Mass Excavation 4 cy to 1.75 cy buckets) | III | 3 |
| | | | 0 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| | No Response | |

## Mass Care Services

**Capability Target:** Within 24 hours, move and deliver resources to meet the needs of disaster survivors, including individuals with special needs and others who may be considered “at-risk”. Within 24 hours Department of Human Services and other supporting agencies (ESF6) will establish, staff, and equip emergency shelters and other temporary housing options ensuring that shelters and temporary housing units are physically accessible for individuals with disabilities and others with access and functional needs.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Mass Care Services | Shelter Management Team (Mass Care) | I | 4 |
| Mass Care Services | Field Kitchen Manager | I | 3 |
| Mass Care Services | State Mass Care Coordinator | I | 1 |

| | | | |
|---|---|---|---|
| Mass Care Services | Field Kitchen Unit | II | 2 |
| Mass Care Services | Shelter Management Team | III | 6 |
| Mass Care Services | Field Kitchen Unit | III | 6 |
| Mass Care Services | Field Kitchen Unit | IV | 6 |

**Other Resources**

| Category: | Resource: | Number Required: |
|---|---|---|
| | No Response | |

## Mass Search and Rescue Operations

**Capability Target:** During the first 12 hours of incident, conduct search and rescue operations to locate and rescue persons in distress, based on the requirements of local authorities. Initiate community based search and rescue support operations across a wide geographically dispersed area. Ensure the synchronized deployment of local, regional, national and international teams to reinforce ongoing search and rescue efforts and transition to recovery.

**NIMS-typed Resources**

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Search and Rescue | US and R Incident Support Team | I | 2 |
| Search and Rescue | Disaster Collapsed Structure Canine Search Technical Specialist (Advisor) | I | 2 |
| Search and Rescue | Canine Search and Rescue Team Land Cadaver Air Scent | I | 3 |

| | | | |
|---|---|---|---|
| Search and Rescue | Swiftwater/Flood Search and Rescue Team | I | 2 |
| Search and Rescue | Urban Search and Rescue (US and R) Task Force Leader | II | 2 |
| Search and Rescue | Urban Search and Rescue (US and R) Task Force | n/a | 2 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Search and Rescue | Structural Collapse Rescue Team, Type I | 2 |
| Search and Rescue | Structural Collapse Rescue Team, Type II | 2 |

## Operational Communications

**Capability Target:** During the first 12 hours of an incident, complete a damage assessment and begin restoration of 12 communication and deploy 1 mobile tower on each island to cover gaps for towers that cannot be quickly be restored to operation across 3 islands.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Fire/Hazardous Materials | Mobile Communications Unit (Law/Fire) | I | 1 |
| Incident Management | Mobile Communications Center (Also referred to as "Mobile EOC") | II | 2 |
| Incident Management | Communications Support Team (CAP) | II | 2 |
| Incident Management | Mobile Communications Center (Also referred to as "Mobile EOC") | IV | 4 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Incident Management | Mobile communication towers | 4 |

## Situational Assessment

**Capability Target:** Within 2 hours of the incident, gather and compile situation reports from 18 territorial agencies to develop and maintain a common operating picture. On a 12 hour, operational period (or as the situation dictates), provide initial and continuous notification of 8 response and recovery partners on the current and probable future situation, verify facts (e.g. incident-related deaths, impassable nodes, shelter counts), and obtain manifests and information on foreseeable and actual adverse cascading events.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Rapid Needs Assessment Team | I | 2 |
| Incident Management | Individual Assistance Disaster Assessment Team | I | 2 |
| Incident Management | EOC Management Support Team | II | 2 |
| Incident Management | Evacuation Coordination Team | II | 2 |
| Medical and Public Health | Receiving, Staging, and Storing (RSS) Task Force | I | 2 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Economic Recovery

**Capability Target:** Within 7 days of an incident, assign economic development assessment teams to conduct a preliminary damage assessment to determine impacts to economic and business recovery, and identify requirements for enhanced territorial or Federal support. Within 8 weeks, develop a plan in concert with economic development team and whole community partners to restore infrastructure sites (grocery stores, banks, tourism) to contribute to resiliency, accessibility, and sustainability of the economy. Within 12 months, develop a plan that identifies pre-disaster mitigation and post-disaster actions that build economic resiliency and reduce recovery delays.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Rapid Needs Assessment Team | I | 1 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Health and Social Services

**Capability Target:** Within 3 days of an incident, conduct an assessment of the community health and social service needs for 106,000 residents, including at-risk individuals, including children, populations with limited English proficiency, and those with access/functional needs, in the affected area.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Critical Incident Stress Management Team | I | 2 |
| Medical and Public Health | Medical/Public Health System Assessment Team | | 2 |
| Medical and Public Health | Environmental Health | | 2 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Housing

**Capability Target:** Within 24 hours of an incident begin preliminary assessment of housing impacts and needs, identify available options for temporary housing of 1500 displaced households, and implement sheltering options. Within 48 hours of an incident begin implementation of housing solutions that effectively support the needs of the whole community and contribute to its sustainability and resilience. Identify housing requirements and available housing, including accessible options for; all families and individuals needed to be sheltered, animals (pets) needing shelter and residences with homes destroyed along with accessibility for people with special needs.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Individual Assistance Disaster Assessment Team | I | 1 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Other | Housing Liaison | 5 |
| Other | Structural Engineer | 5 |
| Other | Disaster Housing Task Force | 5 |

## Natural and Cultural Resources

**Capability Target:** Within 5 days of an incident, commence 100 cultural, and historic property resource damage assessments, using volunteer organizations and territorial/federal agencies involved in natural and cultural resource recovery. Within 6 months of an incident, restore/reopen/remediate multiple museums/libraries and historic properties. Returning them to pre-disaster conditions and/or implementing protective actions will involve another 18 months. Within 12 months of an incident, develop a plan to mitigate future impacts and stabilize multiple cultural resources.

## NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Public Works | Aerial Lift - Truck Mounted | III | 1 |
| Public Works | Wheel Loader Backhoe | | 1 |
| Public Works | Wood Chipper | | 1 |
| Public Works | Truck, Off-Road Dump | | 1 |
| Public Works | Structural Engineer | | 1 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

| | | |
|---|---|---|
| Other | Archeologists | 4 |
| Public Works | General laborers | 4 |

## On-scene Security, Protection, and Law Enforcement

**Capability Target:** During the first 72 hours, Establish a safe and secure environment in an affected area. Provide and maintain on-scene security and meet the protection needs of the affected population over a 134-square mile area on three islands while eliminating or mitigating the risk of further damage to persons, property, and the environment.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Law Enforcement Operations | Bomb Squad/Explosives Team | I | 1 |
| Law Enforcement Operations | Mobile Field Force Law Enforcement (Crowd Control Teams) | I | 2 |
| Law Enforcement Operations | Law Enforcement Patrol Team (Strike Team) | I | 2 |
| Law Enforcement Operations | Law Enforcement Aviation - Helicopters - Patrol and Surveillance | | 3 |
| Law Enforcement Operations | | | 0 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Threats and Hazards Identification

**Capability Target:** Identify and provide context for 5 of the worst-case, plausible threats and hazards to the region every 2 years in collaboration with whole community partners and incorporate it into the analysis and planning processes. Every 2 years, update the threats and hazards list with known and emerging threats and hazards and use pertinent models to estimate potential consequences in collaboration with all partners.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|

**No Response**

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Incident Management | Hazard Mitigation Specialist | 0 |
| Other | Threat and Hazard Identification Specialist | 1 |

## Fire Management and Suppression

**Capability Target:** STT - Conduct life-saving and firefighting operations in response to a structural fire within 5 minutes of notification and maintain operations for 2 hours. STJ - Conduct life-saving and firefighting operations in response to a structural fire within 5 minutes of notification and maintain operations for 1 hours. STX - Conduct life-saving and firefighting operations in response to a wildland fire within 5 minutes of notification and maintain operations for 2 hours. Within the next two years increase water sourcing capabilities thru MOUs with private Water Haulers and water storage bladders

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Fire/Hazardous Materials | Firefighter | I | 70 |
| Fire/Hazardous Materials | Portable Pump | I | 4 |
| Fire/Hazardous Materials | Firefighter | II | 20 |
| Fire/Hazardous Materials | Water Tender, Firefighting (Tanker) | | 5 |
| Fire/Hazardous Materials | Fire Boat | | 1 |
| Fire/Hazardous Materials | Incident Management Team, Firefighting | | 3 |
| Fire/Hazardous Materials | HazMat Technician | | 30 |
| Fire/Hazardous Materials | Brush Patrol, Firefighting (Type VI Engine) | | 4 |
| Fire/Hazardous Materials | Area Command Team, Firefighting | | 3 |
| Fire/Hazardous Materials | Strike Team, Engine (Fire) | | 0 |
| Incident Management | Incident Commander (IC) (Type 3) | III | 5 |
| Public Works | Track Dozer | IV | 1 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Fire/Hazardous Materials | Trailer mounted water tank, 2000 gal | 4 |
| Fire/Hazardous Materials | Mobile 4500 PSI Cascade Air System | 3 |
| Fire/Hazardous Materials | Collapsible water bladder, 20000 gal | 4 |

## Logistics and Supply Chain Management

**Capability Target:** Establish, staff, and supply up to 21 points of distribution to deliver life-sustaining resources to 106,000 residents across 4 islands within 24 hours of an incident.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Incident Management | Logistics Section Chief (Type 3) | | 3 |
| Incident Management | Donations Management Personnel/Team | | 3 |

### Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|

**No Response**

## Public Health, Healthcare, and Emergency Medical Services

**Capability Target:** Within 12 hours of an incident, deliver countermeasures to exposed populations, complete triage and initial stabilization of 3000 casualties, and provide definitive medical care for people likely to survive their injuries or illnesses.

### NIMS-typed Resources

| Category: | Resource: | Type: | Number Required: |
|---|---|---|---|
| Emergency Medical Services | Air Ambulance (Fixed-Wing) | I | 4 |
| Emergency Medical Services | Air Medical Transport Paramedic | I | 8 |
| Emergency Medical | Ambulance Strike Team | I | 2 |

| | | | |
|---|---|---|---|
| Services | | | |
| Emergency Medical Services | Air Medical Transport Manager or Administrator | I | 2 |
| Emergency Medical Services | Air Medical Transport Physician | I | 4 |
| Emergency Medical Services | Air Medical Transport Registered Nurse | | 8 |
| Medical and Public Health | Epidemiology Interviewer | I | 2 |
| Medical and Public Health | Mass Dispensing, Operations Team Consultant | I | 1 |
| Medical and Public Health | Social Worker | I | 2 |
| Medical and Public Health | Assessment Team Leader | I | 2 |
| Medical and Public Health | Epidemiology Team Leader | I | 2 |
| Medical and Public Health | Receiving Staging and Storage (RSS) Task Force Leader | I | 1 |
| Medical and Public Health | Medical/Public Health System Assessment Team | I | 1 |
| Medical and Public Health | Emergency/Critical Care Team | I | 1 |
| Medical and Public Health | Receiving, Staging, and Storing (RSS) Task Force | I | 1 |
| Medical and Public Health | Mobile Field Medical Team | II | 1 |

## Other Resources

| Category: | Resource: | Number Required: |
|---|---|---|
| Medical and Public Health | Strategic National Stockpile Assets | 1 |

## THIRA Journal Notes

-- No Journal Notes --

# THIRA Post-Assessment

**U.S. Virgin Islands**

## Number of Participating Agencies Data

### Federal

#### Emergency Management / Homeland Security

0

#### Fusion Center

0

#### Law Enforcement / Public Safety

0

#### Fire / EMS

0

#### Public Health

0

#### Historic / Cultural Resources

0

#### Environment

0

#### Transportation

0

#### Agriculture

0

#### Executive Branch

0

#### Bureau of Information Technology (BIT)

0

#### Other (specify)

0

### State

#### Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Bureau of Information Technology (BIT)

0

## Other (specify)

0

# Territory

## Emergency Management / Homeland Security

1

## Fusion Center

1

## Law Enforcement / Public Safety

0

## Fire / EMS

1

## Public Health

0

## Historic / Cultural Resources

1

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Bureau of Information Technology (BIT)

1

## Other (specify)

0

# County

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Other (specify)

0

## Bureau of Information Technology (BIT)

0

# UASI

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Bureau of Information Technology (BIT)

0

## Other (specify)

0

# Other City

## Emergency Management / Homeland Security

0

## Fusion Center

0

## Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

## Bureau of Information Technology (BIT)

0

## Other (specify)

0

## Tribal

### Emergency Management / Homeland Security

0

### Fusion Center

0

### Law Enforcement / Public Safety

0

### Fire / EMS

0

### Public Health

0

### Historic / Cultural Resources

0

### Environment

0

### Transportation

0

### Agriculture

0

### Executive Branch

0

### Bureau of Information Technology (BIT)

0

### Other (specify)

0

## Other (specify)

### Emergency Management / Homeland Security

0

### Fusion Center

0

### Law Enforcement / Public Safety

0

## Fire / EMS

0

## Public Health

0

## Historic / Cultural Resources

0

## Environment

0

## Transportation

0

## Agriculture

0

## Executive Branch

0

# Non-Governmental Organizations

## American Red Cross

1

## Community advocacy group

0

## Other (specify)

0

## Port authority / Other port organization

0

## Private sector / Business

0

## Utilities / Public works

0

## Hospital / Healthcare organization

0

## Education community

0

## Disability or access / functional needs community

0

## Other VOAD

0

## Faith-based organization

0

## Other (specify)

## Bureau of Information Technology (BIT)

0

## Other (specify)

0

## Bureau of Information Technology (BIT)

0

## Other (specify)

0

# THIRA Post-Assessment Resources

| | |
|---|---|
| Participant List | <null> |
| Data Sources | Data collected from territorial agencies, individual meetings and exercise after action reports. |
| Limitations | Challenges in finding points of contact and subject matter experts within the territorial agencies that could provide the needed information. |

# THIRA Post-Assessment Modeling Tools

| | |
|---|---|
| ALOHA | not checked |

| | |
|---|---|
| DHS One View | not checked |
| Flood Maps | not checked |
| HAZUS MH | not checked |
| HURREVAC | not checked |
| Landscan USA | not checked |
| National Climate Assessment Report | not checked |
| SLOSH | checked |
| Sea Level Rise Viewer | not checked |
| Corps of Engineers Debris Model | not checked |
| None | not checked |
| Other | checked |
| Other Specification | USVI Tsunami Evacuation maps |

## THIRA Post-Assessment Climate Change Data

| | |
|---|---|
| Were Impacts of Climate Change Included? | Yes |
| Step 1 | checked |
| Step 2 | checked |
| Step 3 | not checked |
| Step 4 | not checked |

| | |
|---|---|
| Describe | The U.S. Virgin Islands is maintaining situational awareness of climate change studies. To date there have not been any studies completed that address the potential impacts of climate change on the territory. The territory sees the potential for the impact of climate change on the mission areas of mitigation, response, and recovery. If current trends continue and support modeling data, the territory could see increased storm surges that could impact a number of response and recovery core capabilities. |

## THIRA Journal Notes

-- No Journal Notes --

~~For Official Use Only~~

# U.S. Virgin Islands 2016 SPR

## SPR Capability Ratings

### Planning

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 4 | N/A | 3 | 2 |

### Public Information and Warning

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 4 | 4 | 3 | 2 | 4 |

### Operational Coordination

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 3 | 3 | 3 | 2 |

### Forensics and Attribution

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 3 | 2 | 4 | 2 |

## Intelligence and Information Sharing

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 3 | 2 | 4 | 3 |

## Interdiction and Disruption

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 3 | 2 | 3 | 3 |

## Risk and Disaster Resilience Assessment

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 3 | 2 | 4 | 4 |

## Access Control and Identity Verification

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 2 | 2 | 2 | 2 |

## Cybersecurity

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |

| | | | | |
|---|---|---|---|---|
| 3 | 3 | 2 | 1 | 2 |

## Physical Protective Measures

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 2 | 2 | 4 | 3 |

## Risk Management for Protection Programs and Activities

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 4 | 2 | 3 | 2 |

## Supply Chain Integrity and Security

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 3 | 2 | 4 | 1 |

## Community Resilience

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 4 | N/A | 3 | 1 |

## Long-term Vulnerability Reduction

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 3 | N/A | 3 | 1 |

## Risk and Disaster Resilience Assessment

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 2 | 2 | 2 | 2 |

## Critical Transportation

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 3 | 3 | 2 | 2 |

## Environmental Response/Health and Safety

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 3 | 2 | 3 | 2 |

## Fatality Management Services

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 3 | 1 | 2 | 2 |

## Infrastructure Systems

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 3 | 2 | 2 | 2 |

## Mass Care Services

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 4 | 2 | 3 | 3 |

## Mass Search and Rescue Operations

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 2 | 2 | 2 | 2 |

## Operational Communications

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 3 | 3 | 3 | 3 |

## Situational Assessment

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 3 | 3 | 2 | 2 |

## Economic Recovery

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 3 | N/A | 2 | 1 |

## Health and Social Services

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 3 | 3 | 3 | 3 | 3 |

## Housing

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 3 | 4 | N/A | 3 | 1 |

## Natural and Cultural Resources

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 1 | 2 | 1 | 2 | 2 |

## On-scene Security, Protection, and Law Enforcement

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 4 | 4 | 4 | 4 | 4 |

## Threats and Hazards Identification

| Internal Ratings | | | | |
|---|---|---|---|---|
| Planning | Organization | Equipment | Training | Exercises |
| 2 | 3 | 2 | 2 | 2 |

## Fire Management and Suppression

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 3 | 4 | 3 | 2 | 3 |

## Logistics and Supply Chain Management

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 2 | 2 | 2 | 3 | 1 |

## Public Health, Healthcare, and Emergency Medical Services

| Internal Ratings | | | | |
|---|---|---|---|---|
| **Planning** | **Organization** | **Equipment** | **Training** | **Exercises** |
| 3 | 3 | 2 | 4 | 3 |

# SPR Functional Areas Gaps

## U.S. Virgin Islands

## Planning

### Planning

| | |
|---|---|
| Continuity planning | checked |
| Evaluating and updating plans | checked |
| Including individuals with disabilities or access/functional needs | checked |
| Integrating different plans | checked |
| Operational planning | checked |
| Strategic planning | checked |
| Whole community involvement and coordination | checked |

### Organization

| | |
|---|---|
| Continuity planning | checked |
| Evaluating and updating plans | checked |
| Strategic planning | checked |
| Whole community involvement and coordination | checked |

### Training

| | |
|---|---|
| Continuity planning | checked |
| Evaluating and updating plans | checked |

| | |
|---|---|
| Integrating different plans | checked |
| Operational planning | checked |
| Strategic planning | checked |
| Whole community involvement and coordination | checked |

### Exercises

| | |
|---|---|
| Continuity planning | checked |
| Evaluating and updating plans | checked |
| Integrating different plans | checked |
| Operational planning | checked |
| Whole community involvement and coordination | checked |

## Public Information and Warning

### Planning

| | |
|---|---|
| Other functional area(s), describe below | checked |

### Organization

| | |
|---|---|
| Culturally and linguistically appropriate messaging | checked |

### Equipment

| | |
|---|---|
| Alerts and warnings | checked |
| New communications tools and technologies | checked |

## Training

| | |
|---|---|
| Alerts and warnings | checked |
| Culturally and linguistically appropriate messaging | checked |
| Delivering actionable guidance | checked |
| Other functional area(s), describe below | checked |

## Exercises

| | |
|---|---|
| Alerts and warnings | checked |
| Culturally and linguistically appropriate messaging | checked |
| Delivering actionable guidance | checked |
| Public awareness campaigns | checked |

# Operational Coordination

## Planning

| | |
|---|---|
| Allocating and mobilizing resources | checked |
| Command, control, and coordination | checked |
| Emergency Operations Center management | checked |
| Stakeholder engagement | checked |

## Organization

| | |
|---|---|
| Emergency Operations Center management | checked |
| Stakeholder engagement | checked |

## Equipment

| | |
|---|---|
| Allocating and mobilizing resources | checked |
| Emergency Operations Center management | checked |
| Ensuring information flow | checked |
| Establishing a common operating picture | checked |

## Training

| | |
|---|---|
| Command, control, and coordination | checked |
| Emergency Operations Center management | checked |
| Establishing a common operating picture | checked |
| NIMS/ICS compliance | checked |
| Stakeholder engagement | checked |

## Exercises

| | |
|---|---|
| Allocating and mobilizing resources | checked |
| Command, control, and coordination | checked |
| Emergency Operations Center management | checked |
| Ensuring information flow | checked |
| Ensuring unity of effort | checked |
| Establishing a common operating picture | checked |
| NIMS/ICS compliance | checked |
| Stakeholder engagement | checked |

# Forensics and Attribution

## Planning

| | |
|---|---|
| Assessing terrorist capabilities | checked |
| Attribution assessments | checked |
| Biometrics analysis | checked |
| CBRNE material analysis | checked |
| Digital media and network exploitation | checked |
| Forensic analysis | checked |
| Terrorist investigations | checked |

## Organization

| | |
|---|---|
| Assessing terrorist capabilities | checked |
| Biometrics analysis | checked |
| CBRNE material analysis | checked |
| Digital media and network exploitation | checked |
| Evidence collection | checked |
| Forensic analysis | checked |
| Terrorist investigations | checked |

| Equipment | |
|---|---|
| Assessing terrorist capabilities | checked |
| Biometrics analysis | checked |
| CBRNE material analysis | checked |
| Digital media and network exploitation | checked |
| Evidence collection | checked |
| Forensic analysis | checked |
| Terrorist investigations | checked |

| Training | |
|---|---|
| Attribution assessments | checked |
| Biometrics analysis | checked |
| Digital media and network exploitation | checked |
| Evidence collection | not checked |
| Terrorist investigations | checked |

## Exercises

| | |
|---|---|
| Assessing terrorist capabilities | checked |
| CBRNE material analysis | checked |
| Digital media and network exploitation | checked |
| Forensic analysis | checked |
| Terrorist investigations | checked |

# Intelligence and Information Sharing

## Planning

| | |
|---|---|
| Analysis of intelligence and information | checked |
| Disseminating intelligence and information | checked |
| Establishing intelligence and information requirements | checked |
| Gathering intelligence | checked |
| Monitoring information | checked |

## Organization

| | |
|---|---|
| Establishing intelligence and information requirements | checked |
| Feedback and evaluation | checked |
| Gathering intelligence | checked |
| Safeguarding sensitive information | checked |

## Equipment

| | |
|---|---|
| Exploiting and processing information | checked |
| Gathering intelligence | checked |
| Monitoring information | checked |
| Safeguarding sensitive information | checked |

## Training

| | |
|---|---|
| Analysis of intelligence and information | checked |
| Disseminating intelligence and information | checked |
| Establishing intelligence and information requirements | checked |
| Exploiting and processing information | checked |
| Gathering intelligence | checked |

## Exercises

| | |
|---|---|
| Continuous threat assessment | checked |
| Developing reports and products | checked |
| Disseminating intelligence and information | checked |
| Feedback and evaluation | checked |

# Interdiction and Disruption

| Planning | |
|---|---|
| Border security | checked |
| CBRNE detection | checked |
| Deterrent law enforcement presence | checked |
| Interdicting cargo, conveyances, and persons | checked |
| Tactical law-enforcement operations | checked |
| Wide-area search and detection | checked |

| Organization | |
|---|---|
| Anti-terrorism operations | checked |
| Border security | checked |
| Deterrent law enforcement presence | checked |
| Interdicting cargo, conveyances, and persons | checked |
| Tactical law-enforcement operations | checked |
| Wide-area search and detection | checked |

| Equipment | |
|---|---|
| Border security | checked |
| Deterrent law enforcement presence | checked |
| Interdicting cargo, conveyances, and persons | checked |

| | |
|---|---|
| Tactical law-enforcement operations | checked |
| Wide-area search and detection | checked |

### Training

| | |
|---|---|
| Border security | checked |
| Deterrent law enforcement presence | checked |
| Interdicting cargo, conveyances, and persons | checked |
| Tactical law-enforcement operations | checked |
| Wide-area search and detection | checked |

### Exercises

| | |
|---|---|
| Deterrent law enforcement presence | checked |
| Interdicting cargo, conveyances, and persons | checked |
| Tactical law-enforcement operations | checked |
| Wide-area search and detection | checked |

## Screening, Search, and Detection

### Planning

| | |
|---|---|
| Promoting an observant nation | checked |
| Screening | checked |
| Wide-area search | checked |

| Organization | |
|---|---|
| Locating terrorists | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |

| Equipment | |
|---|---|
| Chemical and biological detection | not checked |
| Electronic search | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |
| Wide-area search | checked |

| Training | |
|---|---|
| Chemical and biological detection | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |
| Wide-area search | checked |

## Exercises

| | |
|---|---|
| Chemical and biological detection | checked |
| Physical investigation | checked |
| Promoting an observant nation | checked |
| Screening | checked |
| Wide-area search | checked |

# Access Control and Identity Verification

## Planning

| | |
|---|---|
| Controlling cyber access | checked |
| Controlling physical access | checked |
| Verifying identity | checked |

## Organization

| | |
|---|---|
| Controlling cyber access | checked |
| Controlling physical access | checked |
| Verifying identity | checked |

## Equipment

| | |
|---|---|
| Controlling cyber access | checked |
| Controlling physical access | checked |
| Verifying identity | checked |

## Training

| | |
|---|---|
| Controlling cyber access | checked |
| Controlling physical access | checked |
| Verifying identity | checked |

## Exercises

| | |
|---|---|
| Controlling physical access | checked |
| Verifying identity | checked |
| Controlling cyber access | checked |

# Cybersecurity

## Training

| | |
|---|---|
| Continuity of operations for cyber systems | checked |
| Controlling electronic access | checked |
| Detecting malicious activity | checked |
| End-user awareness | checked |
| Guidelines, regulations, and standards | checked |
| Investigating malicious actors | checked |
| Protective measures | checked |
| Securing CIKR and SCADA systems | checked |

| | |
|---|---|
| Sharing threat information | checked |
| Technical countermeasures | checked |

## Exercises

| | |
|---|---|
| Continuity of operations for cyber systems | checked |
| Controlling electronic access | checked |
| Detecting malicious activity | checked |
| Investigating malicious actors | checked |
| Protective measures | checked |
| Securing CIKR and SCADA systems | checked |
| Sharing threat information | checked |
| Technical countermeasures | checked |

## Planning

| | |
|---|---|
| Continuity of operations for cyber systems | checked |
| Controlling electronic access | checked |
| Detecting malicious activity | checked |
| Protective measures | checked |
| Sharing threat information | checked |
| Technical countermeasures | checked |

## Organization

| | |
|---|---|
| Continuity of operations for cyber systems | checked |
| Controlling electronic access | checked |
| Detecting malicious activity | checked |
| Protective measures | checked |
| Sharing threat information | checked |
| Technical countermeasures | checked |

### Equipment

| | |
|---|---|
| Continuity of operations for cyber systems | checked |
| Controlling electronic access | checked |
| Detecting malicious activity | checked |
| Protective measures | checked |
| Technical countermeasures | checked |

## Physical Protective Measures

### Exercises

| | |
|---|---|
| Border protection | checked |
| Identifying and prioritizing assets to protect | checked |
| Site-specific and process-specific risk assessments | checked |
| Other functional area(s), describe below | checked |

### Planning

| | |
|---|---|
| Border protection | checked |

| | |
|---|---|
| Identifying and prioritizing assets to protect | checked |
| Site-specific and process-specific risk assessments | checked |
| Other functional area(s), describe below | checked |

## Organization

| | |
|---|---|
| Border protection | checked |
| Identifying and prioritizing assets to protect | checked |
| Other functional area(s), describe below | checked |
| Site-specific and process-specific risk assessments | checked |

## Equipment

| | |
|---|---|
| Border protection | checked |
| Site-specific and process-specific risk assessments | checked |
| Other functional area(s), describe below | checked |

## Training

| | |
|---|---|
| Identifying and prioritizing assets to protect | checked |
| Site-specific and process-specific risk assessments | checked |
| Other functional area(s), describe below | checked |

# Risk Management for Protection Programs and Activities

## Training

| | |
|---|---|
| Data Collection | checked |

| | |
|---|---|
| Incorporating risk assessments in exercise design | checked |
| Risk assessment | checked |
| Other functional area(s), describe below | checked |

## Exercises

| | |
|---|---|
| Data Collection | checked |
| Risk assessment | checked |
| Risk management planning | checked |

## Planning

| | |
|---|---|
| Analysis tools | checked |
| Data Collection | checked |
| Risk management planning | checked |

## Organization

| | |
|---|---|
| Data Collection | checked |
| Risk assessment | checked |

## Equipment

| | |
|---|---|
| Analysis tools | checked |
| Data Collection | checked |

# Supply Chain Integrity and Security

## Training

| | |
|---|---|
| Analysis of supply chain dependencies | checked |

| | |
|---|---|
| Implementing countermeasures | checked |
| Verification and detection | checked |

### Exercises

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Integrating security processes | checked |

### Planning

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Verification and detection | checked |

### Organization

| | |
|---|---|
| Analysis of supply chain dependencies | checked |
| Integrating security processes | checked |
| Verification and detection | checked |

### Equipment

| | |
|---|---|
| Implementing countermeasures | checked |
| Implementing physical protection | checked |
| Verification and detection | not checked |
| Integrating security processes | checked |

## Community Resilience

### Training

| | |
|---|---|
| Collaborative planning and decision-making | checked |
| Partnership building | checked |

### Exercises

| | |
|---|---|
| Collaborative planning and decision-making | checked |
| Partnership building | checked |

### Planning

| | |
|---|---|
| Collaborative planning and decision-making | checked |
| Partnership building | checked |

### Organization

| | |
|---|---|
| Collaborative planning and decision-making | checked |
| Communication and outreach | checked |

## Long-term Vulnerability Reduction

### Exercises

| | |
|---|---|
| Individual and family preparedness | checked |

### Training

| | |
|---|---|
| Adopting vulnerability reduction standards and building codes | checked |
| Incorporating mitigation measures into construction and development | checked |
| Individual and family preparedness | checked |

### Organization

| | |
|---|---|
| Incorporating mitigation measures into construction and development | checked |
| Individual and family preparedness | checked |
| Adopting vulnerability reduction standards and building codes | checked |

### Planning

| | |
|---|---|
| Incorporating mitigation measures into construction and development | checked |
| Individual and family preparedness | checked |

## Risk and Disaster Resilience Assessment

### Planning

| | |
|---|---|
| Obtaining and sharing data | checked |
| Modeling and analysis | checked |

### Exercises

| | |
|---|---|
| Obtaining and sharing data | checked |

### Training

| | |
|---|---|
| Education and training | checked |

### Equipment

| | |
|---|---|
| Obtaining and sharing data | checked |
| Modeling and analysis | checked |

### Organization

| | |
|---|---|
| Obtaining and sharing data | checked |

# Critical Transportation

## Exercises

| | |
|---|---|
| Reentering affected area | checked |
| Transportation safety and condition assessments | checked |
| Debris removal | checked |

## Equipment

| | |
|---|---|
| Transportation safety and condition assessments | checked |

## Training

| | |
|---|---|
| Reentering affected area | checked |
| Transportation safety and condition assessments | checked |

## Planning

| | |
|---|---|
| Reentering affected area | checked |
| Transportation safety and condition assessments | checked |

## Organization

| | |
|---|---|
| Transportation safety and condition assessments | checked |

# Environmental Response/Health and Safety

## Exercises

| | |
|---|---|
| Decontamination | checked |

| | |
|---|---|
| Hazardous material clean-up | checked |
| Responder safety | checked |

## Training

| | |
|---|---|
| Hazardous material clean-up | checked |
| Predictive modeling | checked |
| Responder safety | checked |

## Equipment

| | |
|---|---|
| Responder safety | checked |
| Debris removal | checked |
| Decontamination | checked |
| Hazardous material clean-up | checked |

## Organization

| | |
|---|---|
| Hazardous material clean-up | checked |
| Health and safety monitoring and assessment | checked |
| Responder safety | checked |
| Decontamination | checked |
| Survivor safety and assistance | checked |

## Planning

| | |
|---|---|
| Health and safety monitoring and assessment | checked |

| | |
|---|---|
| Predictive modeling | checked |
| Responder safety | checked |
| Survivor safety and assistance | checked |

## Fatality Management Services

### Planning

| | |
|---|---|
| Bereavement counseling | checked |
| Body recovery | checked |
| Family reunification | checked |
| Mortuary services | checked |
| Victim identification | checked |
| Other functional area(s), describe below | checked |

### Organization

| | |
|---|---|
| Bereavement counseling | checked |
| Body recovery | checked |
| Mortuary services | checked |
| Victim identification | checked |

### Equipment

| | |
|---|---|
| Body recovery | checked |
| Mortuary services | checked |

| | |
|---|---|
| Other functional area(s), describe below | checked |

### Training

| | |
|---|---|
| Bereavement counseling | checked |
| Body recovery | checked |
| Mortuary services | checked |
| Victim identification | checked |
| Other functional area(s), describe below | checked |

### Exercises

| | |
|---|---|
| Body recovery | checked |
| Mortuary services | checked |
| Victim identification | checked |

## Infrastructure Systems

### Exercises

| | |
|---|---|
| Hospitals | checked |
| Infrastructure site assessments | checked |
| Power restoration | checked |
| Transportation infrastructure | checked |
| Communications systems | checked |

### Training

| | |
|---|---|
| Public safety facilities | checked |
| Transportation infrastructure | checked |
| Communications systems | checked |
| Infrastructure site assessments | checked |

## Equipment

| | |
|---|---|
| Infrastructure site assessments | checked |
| Power restoration | checked |
| Water treatment and provision | checked |
| Communications systems | checked |

## Organization

| | |
|---|---|
| Infrastructure site assessments | checked |
| Power restoration | checked |
| Transportation infrastructure | checked |
| Water treatment and provision | checked |
| Hospitals | checked |

## Planning

| | |
|---|---|
| Hospitals | checked |
| Infrastructure site assessments | checked |
| Power restoration | checked |
| Public safety facilities | checked |

| | |
|---|---|
| Sanitation | checked |
| Transportation infrastructure | checked |
| Water treatment and provision | checked |
| Communications systems | checked |
| Government facilities | checked |

## Mass Care Services

### Exercises

| | |
|---|---|
| Family reunification | checked |
| Feeding | checked |
| Hydration | checked |
| Pets | not checked |
| Relocation assistance | checked |
| Resource distribution | checked |
| Sheltering | checked |

### Planning

| | |
|---|---|
| Family reunification | checked |
| Feeding | checked |
| Pets | checked |
| Resource distribution | checked |

| | |
|---|---|
| Sheltering | checked |

## Organization

| | |
|---|---|
| Family reunification | checked |
| Pets | checked |
| Relocation assistance | checked |
| Resource distribution | checked |

## Equipment

| | |
|---|---|
| Feeding | checked |
| Pets | checked |
| Relocation assistance | checked |

## Training

| | |
|---|---|
| Family reunification | checked |
| Feeding | checked |
| Hydration | checked |
| Pets | checked |
| Resource distribution | checked |
| Sheltering | checked |

## Mass Search and Rescue Operations

### Planning

| | |
|---|---|
| Community-based search and rescue support | checked |
| Rescue operations | checked |
| Search operations | checked |

### Organization

| | |
|---|---|
| Community-based search and rescue support | checked |
| Rescue operations | checked |
| Search operations | checked |
| Synchronizing operations | checked |

### Equipment

| | |
|---|---|
| Community-based search and rescue support | checked |
| Rescue operations | checked |
| Search operations | checked |

### Training

| | |
|---|---|
| Community-based search and rescue support | checked |
| Rescue operations | checked |
| Search operations | checked |
| Specialized operations | checked |

| | |
|---|---|
| Synchronizing operations | checked |
| Other functional area(s), describe below | checked |

## Exercises

| | |
|---|---|
| Community-based search and rescue support | checked |
| Rescue operations | checked |
| Search operations | checked |
| Synchronizing operations | checked |

# Operational Communications

## Exercises

| | |
|---|---|
| Communication between responders and the affected population | checked |
| Interoperable communications between responders | checked |
| Re-establishing communications infrastructure | checked |
| Voice communications | checked |

## Training

| | |
|---|---|
| Voice communications | checked |
| Communication between responders and the affected population | checked |
| Interoperable communications between responders | checked |
| Re-establishing communications infrastructure | checked |

## Equipment

| | |
|---|---|
| Interoperable communications between responders | checked |
| Re-establishing communications infrastructure | checked |
| Data communications | checked |

## Organization

| | |
|---|---|
| Re-establishing communications infrastructure | checked |
| Voice communications | checked |
| Data communications | checked |
| Interoperable communications between responders | checked |

## Planning

| | |
|---|---|
| Interoperable communications between responders | checked |
| Re-establishing critical information networks | checked |

# Situational Assessment

## Exercises

| | |
|---|---|
| Delivering situation reports | checked |
| Stakeholder engagement | checked |
| Tracking response activities | checked |
| Analyzing information | checked |

## Equipment

| | |
|---|---|
| Tracking response activities | checked |
| Analyzing information | checked |

## Training

| | |
|---|---|
| Stakeholder engagement | checked |

## Organization

| | |
|---|---|
| Stakeholder engagement | checked |

## Planning

| | |
|---|---|
| Stakeholder engagement | checked |

# Economic Recovery

## Exercises

| | |
|---|---|
| Reopening businesses | checked |
| Developing recovery objectives | checked |

## Training

| | |
|---|---|
| Economic impact assessments | checked |
| Reopening businesses | checked |
| Business/economic continuity planning | checked |
| Developing recovery objectives | checked |

## Organization

| | |
|---|---|
| Reopening businesses | checked |
| Developing recovery objectives | checked |
| Business/economic continuity planning | checked |
| Economic impact assessments | checked |

### Planning

| | |
|---|---|
| Business/economic continuity planning | checked |
| Developing recovery objectives | checked |

## Health and Social Services

### Exercises

| | |
|---|---|
| Social services | checked |
| Medical products and services | checked |
| Behavioral health | checked |
| Determining health and social needs | checked |

### Training

| | |
|---|---|
| Social services | checked |
| Determining health and social needs | checked |
| Environmental health | checked |
| Behavioral health | checked |

### Equipment

| | |
|---|---|
| Public health measures | checked |
| Social services | checked |
| Determining health and social needs | checked |
| Food safety | checked |
| Healthcare facilities and coalitions | checked |
| Medical products and services | checked |

## Organization

| | |
|---|---|
| Response and recovery worker health | checked |
| Social services | checked |
| Determining health and social needs | checked |
| Behavioral health | checked |
| Health assessment | checked |

## Planning

| | |
|---|---|
| Public health measures | checked |
| School impacts | checked |
| Behavioral health | checked |
| Environmental health | checked |
| Food safety | checked |
| Health assessment | checked |
| Healthcare facilities and coalitions | checked |

# Housing

## Exercises

| | |
|---|---|
| Housing assessments | checked |
| Housing accessibility | not checked |

## Training

| | |
|---|---|
| Housing affordability | checked |
| Reconstruction of destroyed housing | checked |
| Rehabilitation of damaged housing | checked |
| Transition from interim to permanent/long-term housing | checked |
| Housing accessibility | not checked |

## Organization

| | |
|---|---|
| Housing accessibility | checked |
| Reconstruction of destroyed housing | checked |
| Rehabilitation of damaged housing | checked |

## Planning

| | |
|---|---|
| Addressing housing shortages | checked |
| Housing assessments | checked |
| Reconstruction of destroyed housing | checked |
| Rehabilitation of damaged housing | checked |

## Natural and Cultural Resources

### Training

| | |
|---|---|
| Historic preservation | checked |

### Exercises

| | |
|---|---|
| Historic preservation | not checked |
| Other functional area(s), describe below | checked |

### Equipment

| | |
|---|---|
| Damage assessment | checked |
| Environmental preservation and restoration | checked |
| Historic preservation | checked |

### Planning

| | |
|---|---|
| Damage assessment | checked |
| Environmental preservation and restoration | checked |
| Historic preservation | not checked |
| Other functional area(s), describe below | checked |

### Organization

| | |
|---|---|
| Damage assessment | checked |
| Other functional area(s), describe below | checked |

# On-scene Security, Protection, and Law Enforcement

## Exercises

| | |
|---|---|
| Law enforcement | checked |
| Securing disaster areas | checked |

## Equipment

| | |
|---|---|
| Securing disaster areas | checked |

## Training

| | |
|---|---|
| Law enforcement | checked |
| Protecting response personnel | checked |
| Securing disaster areas | checked |

## Planning

| | |
|---|---|
| Protecting response personnel | checked |
| Securing disaster areas | checked |

## Organization

| | |
|---|---|
| Law enforcement | checked |
| Securing disaster areas | checked |

# Threats and Hazards Identification

## Training

| | |
|---|---|
| Stakeholder collaboration/coordination | checked |
| Data collection and sharing | checked |

## Exercises

| | |
|---|---|
| Data collection and sharing | checked |
| Stakeholder collaboration/coordination | checked |

## Planning

| | |
|---|---|
| Data collection and sharing | checked |
| Modeling and analysis | checked |
| Stakeholder collaboration/coordination | checked |

## Organization

| | |
|---|---|
| Modeling and analysis | checked |
| Stakeholder collaboration/coordination | checked |

## Equipment

| | |
|---|---|
| Data collection and sharing | checked |

## Fire Management and Suppression

### Equipment

| | |
|---|---|
| Specialized firefighting | checked |
| Extended attack firefighting | checked |
| Other functional area(s), describe below | checked |
| Structural firefighting | checked |
| Wildland firefighting | checked |

### Training

| | |
|---|---|
| Structural firefighting | checked |
| Specialized firefighting | checked |
| Other functional area(s), describe below | checked |

### Exercises

| | |
|---|---|
| Structural firefighting | checked |
| Wildland firefighting | checked |
| Specialized firefighting | checked |
| Other functional area(s), describe below | checked |

### Planning

| | |
|---|---|
| Specialized firefighting | checked |
| Other functional area(s), describe below | checked |

## Organization

| | |
|---|---|
| Structural firefighting | checked |
| Specialized firefighting | checked |
| Extended attack firefighting | checked |

# Logistics and Supply Chain Management

## Exercises

| | |
|---|---|
| Volunteer management | checked |
| Resource delivery | checked |
| Resource management | checked |

## Training

| | |
|---|---|
| Donation management | checked |
| Resource delivery | checked |
| Resource tracking | checked |
| Volunteer management | checked |

## Organization

| | |
|---|---|
| Resource delivery | checked |
| Resource management | checked |
| Supply chain restoration | checked |
| Volunteer management | checked |

| | |
|---|---|
| Donation management | checked |

## Equipment

| | |
|---|---|
| Emergency power provision | checked |
| Resource delivery | checked |

## Planning

| | |
|---|---|
| Private resources | checked |
| Resource delivery | checked |
| Resource management | checked |
| Supply chain restoration | checked |
| Volunteer management | checked |

# Public Health, Healthcare, and Emergency Medical Services

## Exercises

| | |
|---|---|
| Medical surge | checked |
| Triage and initial stabilization | checked |
| Emergency medical services | checked |

## Training

| | |
|---|---|
| Triage and initial stabilization | checked |
| Health assessments | checked |
| Medical countermeasures | checked |
| Emergency medical services | checked |

| Equipment | |
|---|---|
| Medical surge | checked |
| Triage and initial stabilization | checked |
| Emergency medical services | checked |
| Medical countermeasures | checked |
| Clinical laboratory testing | checked |

| Organization | |
|---|---|
| Emergency medical services | checked |
| Health assessments | checked |
| Medical surge | checked |
| Triage and initial stabilization | checked |

| Planning | |
|---|---|
| Triage and initial stabilization | checked |
| Clinical laboratory testing | checked |
| Definitive care | checked |
| Emergency medical services | checked |
| Medical surge | checked |

# SPR Capability Gaps

## Planning

### Training

Training for Continuity Planning needs to be conducted.

### Planning

TEOP ESF Annexes need to be updated. Continuity Plans need to reviewed and updated.

## Public Information and Warning

### Training

While public education on the sirens has taken place more needs to be done as many residents and businesses do not understand the purpose of the sirens. Training for all newly-hired PIOs required.

### Planning

Planning with cruise lines for public information coordination. External affairs SOP needs to be validated.

### Equipment

More sirens are needed on each island to provide better coverage and allow their use for all hazards. Lack equipment or software to protect sensitive information.

### Organization

Need additional bi-lingual or multi-lingual personnel

### Exercises

Exercises with cruise line public information agencies. Public information not included in all exercises.

## Operational Coordination

### Planning

Up to date and functional EOC SOP.

### Equipment

St. Croix EOC occupies a rented facility with electrical surge issues that need to be corrected so computers can be installed for EOC staff.

### Organization

Agency identification of Emergency Support Coordinators. Agency participation in Emergency Management Council meetings.

### Exercises

Full and consistent participation in exercises

## Forensics and Attribution

### Training

Need to implement multi-agency training to ensure stakeholders function from the same information and execute the same processes. Need training on critical infrastructure and key resources. Need training on managing sensitive information.

### Exercises

More training and exercises needed between both federal and local government agencies. Need increased participation from the private sector. Need increased participation from non-governmental organizations.

## Intelligence and Information Sharing

### Training

Training on critical infrastructure and key resources. Managing sensitive information   Personnel turnover, attrition, or other staffing situations.

### Planning

Need to validate plans through training events, exercises, and/or real-world incidents.

## Screening, Search, and Detection

### Exercises

Need large-scale scenarios that identify "breaking points" for capabilities; exercises have been limited to small-scale scenarios   Need increased participation from non-governmental organizations and the

private sector

# Access Control and Identity Verification

## Planning

Need to assess the state of current plans and ensure they comply with statues, regulations, or standards. Need to develop or complete functional, hazard, threat, or incident specific annexes.

# Cybersecurity

## Training

Cyber security specific trainings need to be provided for all government, non-government, private sector agencies, the community to promote and build resilience.

## Exercises

Need more realistic demonstrations of capability; exercises have been limited to tabletops and proof-of-concept. Need exercises that include cyber objectives and scenarios.

# Physical Protective Measures

## Training

Need increased private sector and/or community outreach and engagement.

## Planning

Need to validate plans through training events, exercises, and real-world incidents.

## Organization

Comprehensive identification of critical infrastructure to the Virgin Islands. Territorial maritime security personnel and equipment

# Risk Management for Protection Programs and Activities

## Training

Tools to improve private sector and/or community outreach and engagement.

## Planning

Coordinate plans with the private and/or non-profit sectors. Improve public outreach regarding plans. Develop or complete functional, hazard, threat, or incident-specific annexes

### Exercises

Participation from the private sector, NGOs, and citizens

## Community Resilience

### Training

Need to conduct private and public-sector partnership training.

### Planning

Need to develop a Business and Industry ESF Annex. Need to coordinate plans with the private and/or non-profit sectors.

### Organization

Need to develop and implement a Business and Industry ESF. Need to conduct more outreach activities with the private sector.

### Exercises

Need to conduct exercises that include the participation of private sector entities and NGOs.

## Critical Transportation

### Planning

Territorial specific port recovery plan need to be developed.

## Environmental Response/Health and Safety

### Organization

Lack of man power to support extended operations.

## Fatality Management Services

### Exercises

Shortage of training equipment

## Mass Care Services

### Training

Feeding and sheltering cruise ship passengers.

### Planning

Feeding and sheltering cruise ship passengers.

### Exercises

Feeding and sheltering cruise ship passengers.

## Mass Search and Rescue Operations

### Training

Open water Search & Rescue, Heavy Urban Search & Rescue

### Planning

Validate plans through training events, exercises, and real-world incidents. Develop or complete functional, hazard, threat, or incident-specific annexes for disaster event. Assess current plans and ensure they comply with statues, regulations, or standards.

### Equipment

Heavy Urban Search & Rescue equipment

### Organization

Open Water Search & Rescue Teams, Heavy Search & Rescue Teams

### Exercises

Focus on large-scale scenarios that identify "breaking points" for capabilities; exercises have been limited to small-scale scenarios. Need increased participation from non-governmental organizations. Need increased participation from the public and private sector.

## Operational Communications

### Planning

The Tactical Interoperable Communications Plan needs to be updated.

### Equipment

Mobile Communication towers Deployable mobile repeater.

### Organization

The Communications Committee as out lined in the Tactical Interoperable Communications Plan needs to re-energized.

## Situational Assessment

### Equipment

St. Croix EOC does not have computers installed so the staff can use WebEOC.

## Economic Recovery

### Organization

Need to develop a Business and Industry ESF and Business EOC.

## Health and Social Services

### Organization

Request for federal assistance will be necessary.

## Housing

### Training

Training gaps resulting from turnover, attrition, or other staffing situations.

### Planning

Need to develop or complete functional, hazard, threat, or incident-specific annexes to address emergency housing during a disaster event. Coordination plans with the private and/or non-profit sectors.

### Exercises

capability is rarely included in exercises.

## Natural and Cultural Resources

### Training

Case Incident System protocol training (radio, septic, purchase & procurement, etc.) Training in coordination and communication directives is needed.

### Planning

There is not at present a written plan by VISHPO to address response and recovery from various disasters. No plan for detailed damage assessments and/or coordination with other agencies.

### Equipment

Equipment would include items such as chainsaws, generators, special equipment such as front-end loaders, etc. Lack of field equipment to carry out damage assessments. A major event would require office and storage areas.

### Organization

At present, there are only two VISHPO personnel capable of carrying out field damage assessments.

## On-scene Security, Protection, and Law Enforcement

### Equipment

Shortage of resources and/or updated equipment

### Organization

Shortage of man power during an emergency event. Due to officers, already being assigned to specific duties.

## Fire Management and Suppression

### Training

Joint training with volunteer organizations. Hazmat Technician Marine Firefighting Capability to conduct group hazmat training on island Incident Command

### Planning

Plans require updating

### Equipment

Marine firefighting equipment to include a fire boat 4 wheeled drive fire apparatus Serviceable hazmat suits and equipment

### Organization

Fire companies are not manned to full strength

## Logistics and Supply Chain Management

### Planning

Territorial Commodity Distribution Plan needs to be revised and updated.ESF-7 Annex needs to be updated.

## Public Health, Healthcare, and Emergency Medical Services

### Training

Trained and equipped EMTs

### Planning

Assess the state of current plans Develop or complete functional, hazard, threat, or incident-specific annexes dealing with Public Health and Medical Services. Coordinate plans with the private and/or non-profit sectors. Improve public outreach regarding plans and available programs and information for the general public.

### Equipment

Operational and fully equipped ambulances.

### Organization

Additional first responder personnel, equipment and resources needed.

### Exercises

Need to implement corrective actions and improvement plans. Need increased focus on large-scale scenarios that identify "breaking points" for capabilities; exercises have been limited to small-scale scenarios. Need increased participation from non-governmental organizations. Need increased participation from the private sector

# SPR Capability Recent Advances

## Planning

### Planning

Implemented a complete revision of the base Territorial Emergency Operations Plan (TEOP)

### Exercises

The Territory is hosting the VIGILANT GUARD 17-3 exercise in May 2017. A number of Territorial agencies and NGO are participating in the exercise planning process which should benefit our threat and hazard planning efforts.

## Public Information and Warning

### Planning

Published the Public Information for All Hazards - ESF 15 SOP

### Organization

USVI Joint Information Center staff identified.

### Equipment

A contract has been let to install 16 new sirens throughout the territory. Advances in public warning capabilities, i.e., WEA, EAS.

### Exercises

Testing of siren system during Caribe Wave exercise. Vigilant Guard 2017 to test/validate USVI JIC.

## Operational Coordination

### Planning

An updated and reformatted EOC SOP is under development.

### Organization

Filled vacancies for St. Thomas and St. Croix EOC Supervisor positions.

## Access Control and Identity Verification

### Equipment

The VI Bureau if Internal Revenue (IRB) has a HSPG funded project planned to upgrade their door access systems and upgrade their ID card database and printing process. The IRB will upgrade their video surveillance system.

## Community Resilience

### Organization

New Outreach Coordinator hired in March 2016.Conducted numerous disaster presentations schools and civic groups.

### Training

Hurricane & tsunami awareness training. Adult and Teen CERT courses.

## Long-term Vulnerability Reduction

### Training

Conducted the following courses in 2016: FEMA P-767, Earthquake Mitigation for Hospitals. FEMA 395, Earthquake Safety & Mitigation for Schools

## Mass Search and Rescue Operations

### Training

Seven personnel from DPNR and St. John Rescue (Volunteer organization) completed a Fast Rescue Boat training course in September. Restarted the Adult and Teen CERT program and have completed 3 Adult and 2 Teen courses since June.

## Operational Communications

### Equipment

Continued upgrades to communications equipment in VITEMA MEOCs and Suburban communications vehicles.

## Situational Assessment

### Training

WebEOC configuration and training conducted in July 2016.USACE conducted HURREVAC training for the VITEMA staff

## Natural and Cultural Resources

### Planning

The 2016-2021 5-Year Historic Preservation Plan will address needs associated with catastrophic events.

### Organization

VISHPO has hired an Historic Preservation Committee coordinator and will be hiring an Historian - these will supplement our manpower needs.

### Equipment

Two new vehicles have been acquired on St. Croix and office systems are complete at present.

### Training

Staff has been trained in CPR and Records Management Data Recovery.

## Threats and Hazards Identification

### Planning

The territory is working to contract a vendor to conduct a modeling project focused on tsunami impacts to the maritime community.

## Fire Management and Suppression

### Training

Live structure firefighting training Driver/operator training LPG firefighting training Confined space training

# Public Health, Healthcare, and Emergency Medical Services

## Equipment

VITEMA worked with St. John Rescue to purchase them an ambulance so the squad could support the limited EMS resources on the island

## Training

VI Fire Service has a plan in place to start EMT training for their personnel

## Exercises

The Vigilant Guard exercise scheduled for May 2017 will include a number of triage, EMS, and medical surge activities

# SPR Gap Responsibility

## U.S. Virgin Islands

## Planning

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Public Information and Warning

| Value | Description |
|---|---|
| 2 | The capability target should be attained solely by the jurisdiction; the jurisdiction will continue to increase this capability until the outcome is met |

## Operational Coordination

| Value | Description |
|---|---|
| 2 | The capability target should be attained solely by the jurisdiction; the jurisdiction will continue to increase this capability until the outcome is met |

## Forensics and Attribution

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Intelligence and Information Sharing

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Interdiction and Disruption

| Value | Description |
|---|---|
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Screening, Search, and Detection

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Access Control and Identity Verification

| Value | Description |
|---|---|
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Cybersecurity

| Value | Description |
|---|---|
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Physical Protective Measures

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Risk Management for Protection Programs and Activities

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Supply Chain Integrity and Security

| Value | Description |
|---|---|
| 2 | The capability target should be attained solely by the jurisdiction; the jurisdiction will continue to increase this capability until the outcome is met |

## Community Resilience

| Value | Description |
|---|---|
| 2 | The capability target should be attained solely by the jurisdiction; the jurisdiction will continue to increase this capability until the outcome is met |

## Long-term Vulnerability Reduction

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Risk and Disaster Resilience Assessment

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Critical Transportation

| Value | Description |
|---|---|
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Environmental Response/Health and Safety

| Value | Description |
| --- | --- |
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Fatality Management Services

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Infrastructure Systems

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Mass Care Services

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Mass Search and Rescue Operations

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Operational Communications

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Situational Assessment

| Value | Description |
|---|---|
| 2 | The capability target should be attained solely by the jurisdiction; the jurisdiction will continue to increase this capability until the outcome is met |

## Economic Recovery

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Health and Social Services

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Housing

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

## Natural and Cultural Resources

| Value | Description |
|---|---|
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of |

government

## On-scene Security, Protection, and Law Enforcement

| Value | Description |
| --- | --- |
| 5 | Current capability already represents the realistic maximum for the jurisdiction; the jurisdiction will continue to rely on outside assets from higher levels of government |

## Threats and Hazards Identification

| Value | Description |
| --- | --- |
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Fire Management and Suppression

| Value | Description |
| --- | --- |
| 2 | The capability target should be attained solely by the jurisdiction; the jurisdiction will continue to increase this capability until the outcome is met |

## Logistics and Supply Chain Management

| Value | Description |
| --- | --- |
| 3 | The jurisdiction will continue to increase the capability; some small portion of capacity will remain reliant on outside assets from higher levels of government |

## Public Health, Healthcare, and Emergency Medical Services

| Value | Description |
| --- | --- |
| 4 | The jurisdiction will potentially increase the capability; a significant portion of required capacity will remain reliant on outside assets from higher levels of government |

# SPR Capability Priorities

**U.S. Virgin Islands**

## High Priority

Public Health, Healthcare, and Emergency Medical Services

Operational Communications

Mass Search and Rescue Operations

Mass Care Services

Fatality Management Services

Cybersecurity

Intelligence and Information Sharing

Planning

## Low Priority

Housing

Health and Social Services

Economic Recovery

On-scene Security, Protection, and Law Enforcement

Environmental Response/Health and Safety

Threats and Hazards Identification

Risk and Disaster Resilience Assessment

Long-term Vulnerability Reduction

Supply Chain Integrity and Security

Risk Management for Protection Programs and Activities

Forensics and Attribution

Natural and Cultural Resources

## Medium Priority

Infrastructure Systems

Situational Assessment

Logistics and Supply Chain Management

Fire Management and Suppression

Critical Transportation

Community Resilience

Physical Protective Measures

Access Control and Identity Verification

Screening, Search, and Detection

Interdiction and Disruption

Operational Coordination

Public Information and Warning

# SPR Assessment Corroboration

### U.S. Virgin Islands

## Housing

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Health and Social Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Economic Recovery

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Infrastructure Systems

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Situational Assessment

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Public Health, Healthcare, and Emergency Medical Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | USVI Maritime Planning Workshop, Operation Pillsbury Sound, |

## Operational Communications

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | USVI Maritime Planning Workshop, |

## On-scene Security, Protection, and Law Enforcement

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | Operation Pillsbury Sound, |

## Mass Search and Rescue Operations

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Mass Care Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | USVI Maritime Planning Workshop, Operation Pillsbury Sound, |

## Logistics and Supply Chain Management

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Fire Management and Suppression

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | TRUE | FALSE | USVI Maritime Planning Workshop, Operation Pillsbury Sound<br><br>March 2016 Yacht fire in Yacht Haven Grande STT |

## Fatality Management Services

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | Operation Pillsbury Sound, |

## Environmental Response/Health and Safety

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | Operation Tide Breaker I, II, III Full-scale exercises. The last Operation Tide Breaker took place two years ago. |

## Critical Transportation

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Threats and Hazards Identification

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Risk and Disaster Resilience Assessment

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Long-term Vulnerability Reduction

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Community Resilience

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Supply Chain Integrity and Security

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Risk Management for Protection Programs and Activities

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Physical Protective Measures

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Cybersecurity

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Increased reports of credit card fraud incidents |

## Access Control and Identity Verification

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | FALSE | TRUE | N/A |

## Screening, Search, and Detection

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | Operation Tide Breaker I, II, and III. Operation Tide Breaker III was conducted in FY14. |

## Interdiction and Disruption

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Tactical Marine Operations with VIFC and Marine Law Enforcement agencies (federal and local) |

## Intelligence and Information Sharing

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | The Virgin Islands Fusion Center participates in information sharing between all levels of governments in collaborative effects during operations, trainings and exercises. |

## Forensics and Attribution

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | Operation Tide Breaker I, II, III |

## Operational Coordination

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | USVI Maritime Planning Workshop, Operation Pillsbury Sound, Earthquake VTTX, |

## Public Information and Warning

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | USVI Maritime Planning Workshop, Operation Pillsbury Sound, Caribe Wave, |

## Planning

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| TRUE | FALSE | FALSE | USVI Maritime Planning Workshop, Operation Pillsbury Sound, Earthquake VTTX, |

## Natural and Cultural Resources

| Based on Exercise Performance? | Based on Event Performance? | Not Based on Exercise or Event? | Reference Exercise or Event |
|---|---|---|---|
| FALSE | TRUE | FALSE | Past hurricanes and tropical storms |

## SPR Journal Notes

-- No Journal Notes --

# SPR Post-Assessment Data

# SPR Post-Assessment Region Data

## County

N/A

## Federal

N/A

## Non-Governmental Organizations

### American Red Cross

1

## Other (specify)

N/A

## Other City

N/A

## State

N/A

## Territory

### Bureau of Information Technology (BIT)

1

### Emergency Management / Homeland Security

1

### Fire / EMS

2

### Fusion Center

1

## Historic / Cultural Resources

1

## Public Health

1

## Tribal

N/A

## UASI

N/A

## SPR Post Assessment Resources

| | |
|---|---|
| **Participant List:** | <null> |
| **Training and Education Course Requirements:** | If possible any training or education courses that are developed should be configured to be exportable to the states and territories.   No specific training or education courses have been identified. |
| **Promising Practices:** | Nothing additional to add. The USVI operates as a single jurisdiction. |

## SPR Post-Assessment Capability Most Progress, Danger

### Most Danger

Public Health, Healthcare, and Emergency Medical Services

Cybersecurity

Operational Coordination

### Most Progress

Community Resilience

Public Information and Warning

Planning

## SPR Post-Assessment Senior Advisory Committee

| | |
|---|---|
| **Charter existence:** | Yes |
| **Key Governance Processes:** | checked |
| **SAC composition:** | checked |
| **How existing governance bodies will be leveraged:** | checked |
| **The frequency at which the SAC will meet:** | checked |
| **How SAC is informed by State's THIRA, SPR data:** | checked |
| **Approach to address gaps in core capabilities:** | not checked |
| **How decisions on programmatic priorities funded:** | checked |
| **How decisions on funded priorities will be documented, shared:** | not checked |
| **Roles and responsibilities for financial decision making:** | not checked |
| **Public distribution:** | No |
| **POC Name:** | Mona L.Barnes |
| **POC Email Address:** | mona.barnes@vitema.vi.gov |

| | |
|---|---|
| **POC Phone Number:** | 340-773-2244 |

## SPR Journal Notes

-- No Journal Notes --